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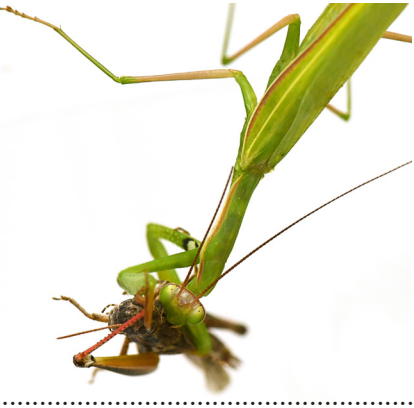

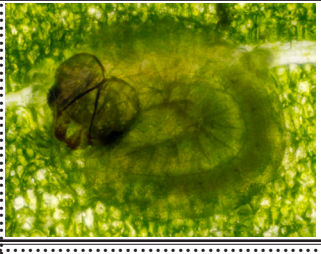

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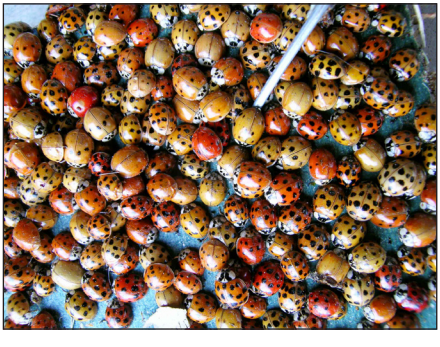
La légende des photos de la couverture se situe sur la couverture arrière.



Cluster of multicoloured Asian lady beetles (Coleoptera: Coccinellidae) [Carman, Manitoba, Canada]
Un agrégat de coccinelles asiatiques (Coleoptera : Coccinellidae) de diverses couleurs [Carman, Manitoba, Canada]
[Photo: John Gavloski]

Up front / Avant-propos

Gail Anderson, President of ESC / Présidente de la SEC

Welcome to spring!

Welcome to spring and the new decade! I know it seems early, but it is time to start thinking about this year's NAtional Insect Appreciation Day (NAIAD)! On 8 June or around that time, we want people to be celebrating all things insect (or other arthropod). Please consider presenting or volunteering to lead entomology expeditions or exercises. Don't forget the excellent resources we have on our website https://esc-sec.ca/entomology-resources/education-and-outreach/ for suggestions for fun activities for all ages, and please pass the message on to schools and museums. The Public Education Committee has produced two excellent posters, and we hope to develop a media list to allow for press releases about events. Étienne Normandin, Chair of the Public Education Committee, is looking into this. We hope to make this a big national day to which people will look forward. These activities do make a big impression, especially on youth. For the last 2 years, my lab and I have given maggot art workshops at National Science Rendezvous at Simon Fraser University. One lady, a return visitor, told her two young sons as they were driving up the mountain, that they were coming to do the Science Day as they had done last year. The boys did not remember

Bienvenue au printemps !

Bienvenue au printemps et dans la nouvelle décennie ! Je sais qu'il est un peu tôt, mais il est déjà temps de penser à la journée nationale des insectes (NAIAD en anglais) de cette année ! Le 8 juin ou autour de cette date, nous voulons que les gens célèbrent les insectes (et les autres arthropodes). Merci d'envisager de donner une présentation ou vous porter volontaire pour mener des expéditions ou des exercices entomologiques. N'oubliez pas les excellentes ressources que nous avons sur notre site web https://esc-sec.ca/fr/entomology-resources/education-and-outreach/ pour des suggestions d'activités amusantes pour tous les âges, et merci de passer le message aux écoles et aux musées. Le comité d'éducation a produit deux excellentes affiches, et nous espérons développer une liste de médias pour des communiqués de presse concernant les événements. Étienne Normandin, président du comité d'éducation, y travaille. Nous espérons faire de cette journée une grande journée nationale à laquelle les gens auront hâte. Ces activités doivent faire une bonne impression, principalement sur les jeunes. Durant les deux dernières années, mon labo et moi avons donné des ateliers d'art d'asticots au Rendez-vous national de sciences à l'Université Simon Fraser. Une dame, une visiteuse qui venait pour la 2e fois, a dit à ses deux jeunes fils, alors qu'elle conduisait vers le haut de la colline, qu'ils se rendaient à la journée des sciences comme l'an dernier. Les garçons ne s'en souvenaient pas et la regardaient d'un regard vide. Mais alors qu'ils approchaient du sommet et qu'ils ont aperçu SFU, ils ont tous deux sauté d'excitation en pointant l'université et en criant « Art d'asticots » ! Ce n'est probablement pas la façon dont l'administration de SFU veut être visualisée, mais cela les a marqués !

and just looked blankly at her. Then, as they neared the top of the mountain and had their first glimpse of SFU, they both jumped with excitement, pointed at the university and said "Maggot Art"! Probably not the way the administration wants SFU to be visualized, but it had made an impression!

I am pleased to announce that we have recently received two excellent 'Canada's Coolest and Cruelest Insects' articles from some of our student award winners from our last JAM and are anticipating more shortly. Please do consider writing or persuading one of your lab mates or students to write an article. They are very short, there is a template, and it really increases the profile of your favourite insect (and as it appears in the Bulletin as well as on Twitter, it is a publication so do encourage your students).

ESC received a request for funding last year for this year's International Congress of Entomology in Helsinki, Finland. We responded by not only supporting ICE financially but by also establishing three travel scholarships, each worth $850, for ESC student members presenting at the conference. I am pleased to announce that are winners are: Carlos Barreto, from Western University, supervised by Dr Zöe Lindo. He is presenting on species distribution modeling to evaluate the impact of climate change on *Nysius simulans* (Hemiptera: Lygaeidae) in soybean crops in South America; Diana Catalina Fernandez, from the University of Windsor. She is supervised by Dr Roselyne Labbé and will discuss population genetics and structure through CO1 gene barcode analysis of the pepper weevil, *Anthonomous eugenii*; and Mathilde Gaudreau of the University of Montreal. She is supervised by Drs Jacques Brodeur and Paul Abram and will speak on how the UV light environment influences host location and exploitation in egg parasitoids. Please do go and see their presentations if you are going to ICE and congratulate them.

While we are talking about conferences, our Local Organizing Committee is working hard on our 2020 ESC/ESA JAM, the first ever

Je suis heureuse d'annoncer que nous avons récemment reçu un excellent article des « bestioles les plus cools/cruelles du Canada » d'un gagnant d'un prix étudiant de notre dernière réunion annuelle, et nous en anticipons davantage prochainement. Merci d'envisager d'écrire un article ou de convaincre un de vos collègues de labo ou de vos étudiants de le faire. Ces articles sont très courts, il y a un modèle disponible, et ils augmentent vraiment la visibilité de votre insecte favori (et puisqu'il apparaît dans le Bulletin ainsi que sur Twitter, il s'agit d'une publication, alors encouragez vos étudiants).

La SEC a reçu une demande de financement l'an dernier pour la Conférence internationale d'entomologie (ICE) de cette année à Helsinki, Finlande. Nous avons répondu non seulement en soutenant la ICE financièrement, mais également en établissant trois bourses de voyage, de 850 $ chacune, pour les membres étudiants présentant à la conférence. Je suis heureuse d'annoncer que les gagnants sont : Carlos Barreto de l'Université Western, supervisé par Dre Zöe Lindo. Il parlera de la modélisation de la distribution des espèces pour évaluer l'impact des changements climatiques sur *Nysius simulans* (Hemiptera : Lygaeidae) dans les cultures de soya en Amérique du Sud ; Diana Catalina Fernandez de l'Université de Windsor. Elle est supervisée par Dre Roselyne Labbé et parlera de la génétique et de la structure des populations par analyse des codes à barres du gène CO1 du charançon du poivron, *Anthonomous eugenii* ; et Mathilde Gaudreau de l'Université de Montréal. Elle est supervisée par Dr Jacques Brodeur et Dr Paul Abram et parlera de la façon dont l'environnement lumineux UV influence la localisation et l'exploitation de l'hôte chez les parasitoïdes des œufs. Si vous allez à la ICE, allez voir leurs présentations et félicitez-les !

Alors que nous parlons de conférences, notre comité organisateur local travaille d'arrache-pied sur la réunion annuelle conjointe SEC/SEAb 2020, la première organisée à Calgary. La conférencière d'honneur sera Dre

hosted in Calgary. The keynote speaker will be Dr Laura Lavine, Professor and Chair of the Washington State University Department of Entomology, while the Heritage Lecture will be delivered by Dr Doug Colwell, AAFC-Lethbridge. There will be six interesting and diverse symposia:

- Innovative and collaborative approaches to conserving Canada's at-risk butterflies (Jessica Linton)
- Migratory pests in Canada: seeing the big picture, with a vision of monitoring and control in a massive country (Tyler Wist & Julien Saguez)
- Rocky mountain high: visions of alpine/subalpine biodiversity from the peaks (Greg Pohl & Dave Langor)
- Shared vision: supporting community engagement with entomology (Catherine Scott & Morgan Jackson)
- A new vision for biological control in Canadian forest ecosystems (Chris MacQuarrie)
- Innovations in semiochemical-based pest management (Maya Evenden & Boyd Mori).

And don't forget the exciting pre-meeting field trip! Keep an eye on the website https://jam2020.ualberta.ca/ for updates.

And finally, a request. Are you interested in financial matters? Have you always wanted to do something for your society but didn't know who to ask? Well now is your chance! ESC is looking for a new Treasurer. We are very sad to see Joel Kits go and thank him for his excellent service, but he is moving on, so we are now in need of a new Treasurer. Are you interested or do you know anyone who might be excited by this new opportunity? There are no longer any geographical restrictions on where the Treasurer must reside. There is an official notice about this on page 70 of this issue.

Laura Lavine, professeure et directrice du département d'entomologie de l'Université de l'état de Washington, alors que l'allocution du patrimoine sera livrée par Dr Doug Colwell, AAC-Lethbridge. Il y aura six symposiums intéressants et divers :

- Des approches innovatrices et collaboratives pour conserver les papillons en péril au Canada (Jessica Linton)
- Les ravageurs migrateurs au Canada : vision globale de la surveillance et de la lutte dans un pays immense (Tyler Wist & Julien Saguez)
- Les montagnes Rocheuses : vision de la biodiversité alpine/subalpine à partir des sommets (Greg Pohl & Dave Langor)
- Une vision commune : soutenir l'engagement des communautés par l'entomologie (Catherine Scott & Morgan Jackson)
- Une nouvelle vision de la lutte biologique dans les écosystèmes forestiers au Canada (Chris MacQuarrie)
- Des innovations dans la lutte aux ravageurs basée sur les substances sémiochimiques (Maya Evenden & Boyd Mori).

Et n'oubliez pas l'excursion préréunion ! Surveillez le site web pour des mises à jour https://jam2020-fr.ualberta.ca/.

Et finalement, une requête. Êtes-vous intéressés par les questions financières ? Avez-vous toujours voulu faire quelque chose pour votre société sans savoir à qui demander ? Voici votre chance ! La SEC est à la recherche d'un nouveau trésorier. Nous sommes très tristes de voir Joel Kits s'en aller, et nous le remercions pour son excellent service, mais il passe maintenant à autre chose alors nous devons trouver un nouveau trésorier. Êtes-vous intéressés ou connaissez-vous quelqu'un qui pourrait être attiré par cette nouvelle opportunité ? Il n'y a pas de restrictions géographiques sur l'endroit où doit demeurer le trésorier. Il y a une annonce officielle à ce sujet à la page 70 de ce numéro.

2020 Joint Annual Meeting of the Entomological Society of Canada and Entomological Society of Alberta

18–21 October 2020
Carriage House Inn, Calgary, Alberta

On behalf of the Entomological Societies of Canada and Alberta, we are pleased to invite you to the **ESC-ESAB 2020 Joint Annual Meeting: 2020 Visioning**, 18–21 October 2020 in Calgary.

Join us for a fresh look at our insect science and where it's moving. Whether changing focus between past and future, regional and global, zooming in on the minutiae or taking a wide angle view, let's get together to generate some new clarity, perspectives and ideas in our entomological pursuits!

After several years of joint meetings with other societies, JAM 2020 marks a return to regular ESC programming. Visit https://jam2020.ualberta.ca/ for more information.

Keynote Speaker – Dr Laura Lavine

Dr Laura Lavine is Professor and Chair of the Washington State University Department of Entomology. Dr Lavine received her PhD in Entomology at the University of Kentucky and was a USDA NIFA Postdoctoral Fellow at the University of Wisconsin-Madison with National Academy of Science member Michael R. Strand before moving to WSU in 2001. Her research program on the evolution of adaptation has focused on understanding the mechanisms underlying an arthropod's ability to rapidly adjust to its environment.

Symposia

- Innovative and collaborative approaches to conserving Canada's at-risk butterflies
- Migratory pests in Canada: seeing the big picture, with a vision of monitoring and control in a massive country
- Rocky mountain high: visions of alpine/subalpine biodiversity from the peaks
- Shared vision: supporting community engagement with entomology
- A new vision for biological control in Canadian forest ecosystems
- Innovations in semiochemical-based pest management

Special Field Trip excursion: Royal Tyrrell Museum. **See details on p. 6**
(extra fee of $60/person, space is limited)

2020 Réunion conjointe annuelle des sociétés d'entomologie du Canada et du Alberta

18–21 octobre 2020
Carriage House Inn, Calgary, Alberta

Au nom des Sociétés d'entomologie du Canada et de l'Alberta, nous sommes ravis de vous inviter à la Réunion annuelle conjointe SEC-SEAB 2020 : Visualisation 2020, du 18 au 21 octobre 2020 à Calgary.

Joignez-vous à nous pour un regard neuf sur la science des insectes et la direction qu'elle prend. Que ce soit pour changer la mise au point entre le passé et le futur, le régional et le global, pour un zoom sur les minuties ou pour prendre un angle de vue plus large, réunissons-nous pour générer de la clarté, des nouvelles perspectives et des idées de nos poursuites entomologiques!

Après plusieurs années de réunions conjointes avec d'autres sociétés, la réunion 2020 marquera un retour vers la programmation régulière de la SEC. Visitez https://jam2020-fr.ualberta.ca for plus d'informations.

Conférencière Principale – Dre Laura Lavine

Dre Laura Lavine est professeure et directrice du département d'entomologie de l'Université de l'état de Washington. Dre Lavine a obtenu son doctorat en entomologie de l'Université du Kentucky et a été hercheure postdoctorale financée par le USDA NIFA à l'Université du Wisconsin-Madison avec le membre de l'Académie nationale des sciences, Michael R. Strand, avant d'aller à WSU en 2001. Son programme de recherche sur l'évolution de l'adaptation porte sur la compréhension des mécanismes sous-jacents à l'habilité des arthropodes à s'ajuster rapidement à leur environnement.

Symposiums

- Des approches innovatrices et collaboratives pour conserver les papillons en péril au Canada
- Les ravageurs migrateurs au Canada : vision globale de la surveillance et de la lutte dans un pays immense
- Les montagnes Rocheuses : vision de la biodiversité alpine/subalpine à partir des sommets
- Une vision commune : soutenir l'engagement des communautés par l'entomologie
- Une nouvelle vision de la lutte biologique dans les écosystèmes forestiers au Canada
- Des innovations dans la lutte aux ravageurs basée sur les substances sémiochimiques

Excursion spéciale : Musée royal Tyrrell. Voir les détails à la p. 6
(frais additionnels de 60 $/personne, nombre de places limité)

Field Trip (extra fee of $60/person, space is limited)

Keeping in mind that understanding the past is important in looking forward into the future, we've arranged a fabulous field trip to Drumheller, home to the **Royal Tyrrell Museum**, on **Saturday, 17 October 2020.** The Royal Tyrrell Museum is Canada's only museum dedicated exclusively to the science of paleontology. In addition to visiting one of the world's largest displays of dinosaurs, our field trip includes a behind-the-scenes tour and a presentation by Dr Annie Quinney (Department of Geoscience at the University of Calgary). Dr Quinney will tell us about amber (the subject of her PhD research), valued not only by entomologists as a source of insect fossils but also by the public as a gemstone. Unfortunately, as Dr Quinney will explain, this has led to the production of fakes, some difficult to tell apart from genuine amber.

We are limited to 55 participants. Our bus will be leaving the Carriage House Inn at 8:30 AM and returning by 5 PM on Saturday, 17 October. Admission to the museum is covered, and you can purchase your own lunch at the museum cafeteria. What a great adventure for $60 per person! For more information, visit https://jam2020.ualberta.ca/excursions/.

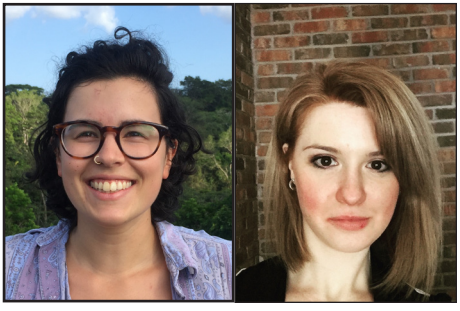
Excursion (frais additionnels de 60 $/personne, nombre de places limité)

En gardant en tête que de comprendre le passé est important pour planifier l'avenir, nous avons organisé un voyage fabuleux à Drumheller, hébergeant le **Muséum royal Tyrrell le samedi 17 octobre 2020**. Le Muséum royal Tyrrell est le seul musée du Canada exclusivement dédié à la science de la paléontologie. En plus de visiter une des plus grandes expositions de dinosaures au monde, notre excursion inclut un tour dans les coulisses et une présentation par Dre Annie Quinney (Département de géosciences de l'Université de Calgary). Dre Quinney nous parlera de l'ambre (le sujet de ses recherches doctorales), de grande valeur non seulement pour les entomologistes comme source de fossiles d'insectes, mais également pour le grand public comme pierre précieuse. Malheureusement, comme Dre Quinney l'expliquera, cela a mené à la production de faux, certains difficiles à distinguer de l'ambre véritable.

Nous avons une limite de 55 participants. Notre autobus quittera le Carriage House Inn à 8 h 30 et reviendra à 17 h le samedi 17 octobre. L'entrée au musée est incluse et vous pourrez acheter votre diner à la cafétéria du musée. Quelle belle aventure pour 60 $/personne ! Pour plus d'information, visitez https://jam2020-fr.ualberta.ca/excursion/.

STEP Corner / Le coin de la relève

Anne-Sophie Caron and Rachel Rix



Research roundup

We continue to publicize graduate student publications to the wider entomological community through our Research Roundup initiative. Check out the ESC blog for most recent featured articles. If you want your recently published article featured (or we missed yours last month!), send us an email at students@esc-sec.ca. For regular updates on new Canadian entomological research, you can join the ESC Students
Facebook page or follow us on Twitter @ esc_students.

Getting involved with the ESC

The Student and Early Professional Affairs Committee (SEPAC) is looking for new members (especially Early Professionals). Volunteering for SEPAC is a great way to get involved with the Society and promote entomology to students across Canada. If you are interested in joining or just have suggestions for new initiatives in the coming year, email us at students@esc-sec.ca, or contact us personally at annesophie.caron.p@gmail.com or Rachel.Rix@dal.ca We look forward to hearing from you,

Anne-Sophie and Rachel.

Aperçu de la recherche

Nous continuons à faire la publicité des publications des étudiants gradués auprès de la communauté entomologique via notre initiative Aperçu de la recherche. Consultez le blogue de la SEC pour les plus récents articles. Si vous voulez que votre plus récent article soit mis en vedette (ou si nous l'avons manqué le mois dernier!), envoyez-nous un courriel à students@esc-sec.ca. Pour des mises à jour régulières sur la recherche entomologique canadienne, adhérez à la page Facebook des étudiants de la SEC ou suivez-nous sur Twitter à @esc_students.

S'impliquer au sein de la SEC

Le comité des affaires étudiantes et des jeunes professionnels cherche de nouveaux membres (particulièrement des jeunes professionnels). S'impliquer bénévolement pour le comité est une excellente façon de s'impliquer dans la Société et promouvoir l'entomologie auprès des étudiants au Canada. Si vous êtes intéressés à joindre le comité, ou si vous avez des suggestions pour de nouvelles initiatives pour la prochaine année, écrivez-nous à students@esc-sec.ca. Vous pouvez aussi nous contacter personnellement à annesophie.caron.p@gmail.com ou Rachel.Rix@dal.ca. Au plaisir d'avoir de vos nouvelles,

Anne-Sophie et Rachel.

Thesis Roundup / Foisonnement de thèses

If you or a student you know has recently defended an entomology-related thesis at a Canadian University, and would like notice of this accomplishment published here and on the ESC website, please email students@esc-sec.ca with the relevant information (name, date, degree, thesis title, supervisor[s], and university).

Si vous, ou un étudiant que vous connaissez, avez récemment soutenu votre thèse dans un domaine lié à l'entomologie dans une université canadienne, et que vous voulez publier l'avis de cette réalisation ici et sur le site web de la SEC, merci d'envoyer les informations pertinentes (nom, date, diplôme, titre de la thèse, directeur[s] et université) à students@esc-sec.ca.

Grossi, Alexandra. PhD. 2020. Bird-associated permanent ectosymbionts examined at coarse and fine scales. Supervisor: Heather Proctor, University of Alberta.

News from the Regions / Nouvelles des régions

Entomological Society of Alberta

Insect calendar available

As a personal hobby, Dan Johnson (University of Lethbridge) makes calendars with insects (and in the past, some flowers, geology, etc.). For 2020, he decided to make it just on grasshoppers, and to use only photos from 2019 and only from Alberta. Anyone who wants a copy on their PC, or to email, post, etc., can find Canadian holiday format and also USA holiday format at the link below.

http://scholar.ulethbridge.ca/danjohnson/links

Entomological Society of Saskatchewan

The Society held its Annual General Meeting on 13 December 2019, with an opening presentation by Society Secretary Iain Phillips entitled “Biological Tools for Water Security in the Northern Great Plains”. Ishita Patel received the ESS Presentation Award for her paper “Pea aphid fecundity and biosis on wild and cultivated lentil species”, given at the Joint Meeting of the Alberta and Saskatchewan Societies held in Fall 2019. Ishita is an MSc student in the Department of Plant Sciences, University of Saskatchewan, supervised by Albert Vandenberg. The Arthur R. Brooks Memorial Prize in Entomology was not awarded in 2019.

People in the news / Gens qui font les manchettes

Charles Vincent

During the XIX International Plant Protection Congress held on 10-14 November 2019 in Hyderabad, India, Charles Vincent was presented with the International Plant Protection Award of Distinction.

Durant le XIX International Plant Protection Congress tenu du 10 au 14 novembre 2019 à Hyderabad, Inde, Charles Vincent a reçu le International Plant Protection Award of Distinction.

M. Parajulee

From left to right/ De gauche à droite: Geoff Norton (President / Président, International Association for the Plant Protection Sciences); Charles Vincent; Rajan Sharma (Secretary / Secrétaire, Local Arrangements Committee); Hari C. Sharma (Chair / Président, Local Arrangements Committee).

Gold Medal Address / Allocution du médaillé d'or

Peter Mason

The state of biological control in Canada

The title of this contribution derives from the Food and Agriculture Organization of the United Nations initiative to report on "The State of the World's Biodiversity for Food and Agriculture (BFA)" which describes the numerous contributions BFA makes to food and agriculture (e.g., nutrition, food security, supporting people's livelihoods, resiliency of production systems, sustainable food production), the multiple ecosystem services it provides, the drivers of change, the status of its various components, the state of management and the challenges faced, and capacity to support sustainable use (FAO 2019). Biological control is one component that contributes to BFA, and understanding the state of biological control in Canada is a first step towards ensuring its sustainable use in the future.

Insects, like all other organisms, move around seeking opportunities to exploit new environments not only to find new sources of food but also to escape from those species that exploit them. Thus, non-native species have been appearing in regions where they have not previously occurred since the beginning of life on earth. During the Anthropocene, the movement of non-native species has increased dramatically due to globalization of trade and travel. Of those that show up in new regions, most either don't survive or integrate into local food webs, existing with species that are already present. A few, however, are able to exploit their new environments in such a way that their numbers increase dramatically and these large populations cause dramatic changes. Some non-native plants will cover large expanses of land, by being better at using available resources than their new neighbours or by secreting compounds that inhibit their new neighbours' ability to survive. Some non-native arthropods feed on crops, reducing their yields. In this latter case, the crops themselves are non-native species that are grown in monocultures, providing an easily accessible and abundant food source!

Problem non-native species are estimated to cost Canadian agriculture $6.7 billion ($5.3–$13.9 billion) per annum (Coulatti et al. 2006). Historically, Europe was the major source of non-native plants and arthropods that caused economic and environmental damage in Canada. Currently, the eastern Palaearctic region, mainly China and Japan, has become a source of problem non-native species. At least 15% of problem non-native plants in Canada are from this region; for example, Japanese knotweed, *Reynoutria japonica* Houttuijn (Polygonaceae) was reported in the 1990s, and two major agricultural pests recently arrived in Canada, namely, spotted wing drosophila, *Drosophila suzukii* (Matsumura) (Diptera: Drosophilidae) (2009) and brown marmorated stink bug, *Halyomorpha halys* Stål (Hemiptera: Pentatomidae) (2010). There is high potential for more problem non-native species to arrive in Canada, such as the spotted lanternfly, *Lycorma delicatula* (White) (Hemiptera: Fulgoridae), light brown apple moth, *Epiphyas postvittana* (Walker) (Lepidoptera: Tortricidae), and European cherry fruit fly, *Rhagoletis cerasi* (L.) (Diptera: Tephritidae).

The challenge is to find ways to reduce populations of problematic non-native species to ensure that human interests are not compromised. Short-term solutions (e.g., chemicals that reduce populations) have a variety of impacts, such as eliminating beneficial pollinators and other species, carbon emissions to produce them, and effects on human health. Thus, there is a great need for long-term strategies to prevent non-native species from increasing to high levels in the first place. This is where biologically-based strategies come into play. The Food and Agriculture Organization (FAO) promotes Integrated Pest Management (IPM) as the preferred approach to

crop protection, considering it as a *"pillar of both sustainable intensification of crop production and pesticide risk reduction*" (FAO 2019). Biological control is a cornerstone of IPM.

History of Biological Control

Biological control has a very long history, dating back over 2300 years when Chinese citrus fruit growers transferred predacious ants to aphid infested orchard trees to reduce pest populations (Debach 1964). Since then, natural enemies have been introduced throughout the globe to control pest species, although these actions have not been without controversy. There are several examples of introductions gone wrong and these have tainted the reputation of biological control. In these 'early days' knowledge of biodiversity was limited and there was a clear lack of understanding of the ecological implications of introducing natural enemies. Thus, a 'shotgun' approach was often taken, whereby multiple natural enemy species (often generalists) were introduced until one or more species reduced the problem species. Biological control today is very much science-based and is implemented in the context of the ecosystem services it provides. The evolutionary relationships between natural enemy candidates for introduction and the food webs that will receive them are important considerations. Mathematical models are becoming increasingly important to predict interactions of target species and their natural enemies. Molecular tools are enabling precise documentation of presence, movement and impacts of natural enemies.

Definition of Biological Control

Heimpel and Mills (2017) define biological control as the "Actions precipitated by living organisms or viruses against target organisms that cause harm to humans or their resources." They separate biological control into four types:

- **Natural biological control** – natural enemies already present in the environment (naturally occurring) that contribute to supressing target species;
- **Conservation biological control** – creating environmental conditions to enhance the populations of natural enemies (native and non-native) of target species;
- **Augmentative biological control** – introduction of mass produced (commercial) natural enemies (invertebrates, pathogens) into a restricted area (not self-perpetuating populations);
- **Importation biological control** – introduction of natural enemies (invertebrates, fungi) from the area of origin of non-native species.

Excluded are products such as biopesticides or biorationals, that, while biologically based, are derivatives of organisms that require external inputs. Microorganisms applied as living organisms, sometimes sold as biopesticides, are included in Heimpel and Mills' definition.

Biological Control in Canada

In Canada, the different types of biological control have been implemented to varying degrees.

Natural Biological Control is the basis on which other biological control strategies are built, yet there are still improvements to be made. Inventories of natural enemies already present in the ecosystem provide information on what species are already present and insight into what is missing. Life table studies help to determine what niches are occupied and the impact of existing natural enemies on particular life stages of the problem species. The value of this ecosystem service (natural pest suppression) to Canadian agriculture was estimated to be $5.03 billion in 2010 (Étilé 2013).

Conservation Biological Control has been implemented in a limited way in Canada. Very few studies have examined the effect of the landscape context on pests and their natural enemies,

mainly in orchard systems in the east. In Canada, the issue of geographic scale is particularly important (Étilé 2013). In eastern Canada, Martin et al. (1989) studied the effect of intercropping corn with soybean on reduction of European corn borer, *Ostrinia nubilalis* (Hübner) (Lepidoptera: Crambidae), Fréchette et al. (2008) studied the impact of ground cover and cultivar on aphid and predator populations in an apple orchard, and Maisonhaute et al. (2010) looked at the effects of agronomic practices, local environment and landscape scale on assemblages of Carabidae (Coleoptera) in corn fields in Québec. In the larger scale agriculture of western Canada, Samaranayake and Costamagna (2018) examined predator movement between crop and adjacent habitats across a gradient of landscape complexity to determine suppression of soybean aphid, *Aphis glycines* Matsumara (Hemiptera: Aphididae).

Augmentative Biological Control is largely industry driven and is mainly used in greenhouse environments, although occasional use in other closed environments, such as building atria, and some field crop environments occurs. Mass production of natural enemies in Canada is conducted by the British Columbia-based Applied Bio-nomics (11 species), the Dutch-based Koppert (16 species) and Belgium's BioBest (26 species). The Québec-based Anatis Bioprotection, a recent player, produces seven natural enemies. Several of the natural enemies in production are native species, for example, Applied Bionomics' *Dicyphus hesperus* Knight (Hemiptera: Miridae), *Gaeolaelaps gillespiei* Beaulieu (Megostigmata: Laelapidae), *Neoseiulus fallacis* (Garman) (Megostigmata: Phytoseiidae) and BioBest's *Sphaerophoria rueppellii* (Weidemann) (Diptera: Syrphidae). Canadian researchers have contributed to moving the commercial greenhouse industry forward by developing native generalist predators (Gillespie et al. 2007) and by partnering with the industry to develop integrated crop management practices that have changed production "… from a reliance on pesticides to a reliance on biological control …" (Shipp et al. 2007).

The Okanagan-Kootenay Sterile Insect Release Program in British Columbia is a public-private-funded area-wide management program that has reduced populations of the non-native codling moth, *Cydia pomonella* (L.) (Lepidoptera: Tortricidae) for 25 years (Thistlewood and Judd 2019). This has been achieved over a large area (3395 to 7331 ha) of orchards and adjacent urban, public, and First Nations lands (Thistlewood and Judd 2019).

Importation Biological Control is generally government driven with Agriculture and Agri-Food Canada (weeds, arthropods) and the Canadian Forest Service (arthropods) being the main players. Some projects have also been led by universities (e.g., British Columbia, Carleton, Manitoba, Montréal, Simon Fraser). Over the years there have been a number of successful projects against weeds (18) (Vankosky et al. 2017), forest arthropod pests (15) (MacQuarrie et al. 2016), and agriculture arthropod pests (16) (unpublished). Notable successes include the introduction of *Agrypon flaveolatum* (Gravenhorst) (Hymenoptera: Ichneumonidae) and *Cyzenis albicans* (Fallén) (Diptera: Tachinidae) to reduce high populations of winter moth, *Operophtera brumata* L. (Lepidopera: Geometridae) in forests in Nova Scotia and British Columbia (Roland 1994, MacQuarrie et al. 2016). *Neogalerucella calmariensis* (L.) and *N. pusilla* Duftschmid (Coleoptera: Chrysomelidae) were introduced to suppress purple loosestrife, *Lythrum salicaria* L. (Lythraceae) (Corrigan et al. 2013). The introduction of *Tetrastichus julis* (Walker) (Hymenoptera: Eulophidae) is the principle factor contributing to mortality of cereal leaf beetle, *Oulema melanopus* (L.) (Coleoptera: Chrysomelidae) across Canada and the USA (Harcourt et al. 1984; Kher et al. 2013).

As noted earlier, biological control in 2019 is a science-based discipline that is highly regulated. Importation biological control, historically the main strategy used, can best illustrate these points. Conceptually, each project can be divided into a number of steps, each of which can take multiple years to complete (Figure 1).

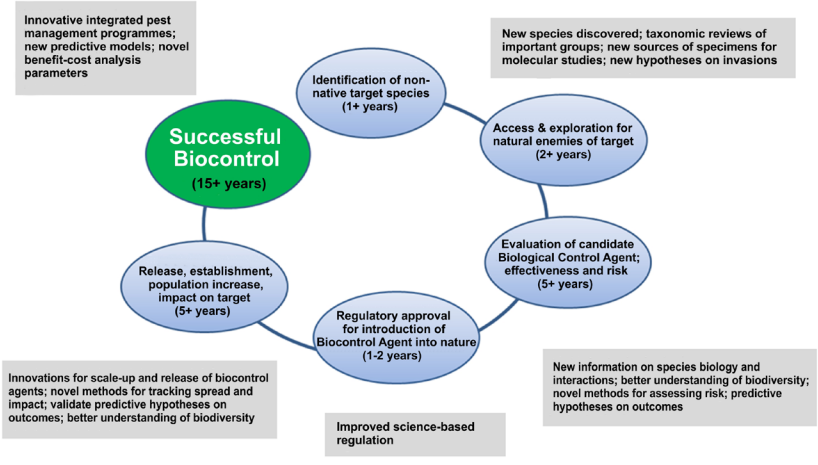


Figure 1. Representation (approximate timelines) of the steps involved and outputs in an importation biological control project. At a finer scale, some steps may be subdivided into multiple components.

Successful Biological Control

When populations of a target species (native or non-native) are reduced by natural enemies to levels that are not problematic, biological control is considered to be successful. Throughout the project cycle, scientific outputs contribute to improving understanding of the organisms involved and their ecological interactions. Whether considered successful or not, biological control research projects generate significant amounts of data which is necessary for developing predictive models to improve decision-making (Roitberg and Gillespie 2014).

The State of Biological Control in Canada

Internationally, biological control is a recognized strategy for dealing with problem non-native species (Convention on Biological Diversity 2018, FAO 2019). It has evolved into a science-based discipline that provides a wealth of data for addressing ecological and evolutionary questions. Importation and inundative biological control activities are regulated by the CFIA, improving the safety of non-native species that are introduced (Mason et al. 2017).

In Canada, the state of biological control in 2019 can be summarized as follows:

- **Natural biological control** – is the basis for other biological control efforts BUT needs to be better understood.
- **Conservation biological control** – is an important strategy BUT greater effort is needed to enable implementation, especially at larger scales.
- **Inundative biological control** – is a thriving commercial industry BUT continued efforts are required to advance understanding of the biology and ecology of natural enemies and their role in crop systems.
- **Importation biological control** - has resulted in some successes BUT there is a need to improve predictability.

In summary, there is much to celebrate about biological control in Canada.

To close, I sincerely thank the Entomological Society of Canada who awarded me the Gold Medal. It is an honor and very humbling to be recognized by this community. It is also recognition for the many collaborators I have had the pleasure to work with and for those who opened the doors along my career path. I also thank those who were kind enough to submit my nomination.

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Wider aspects of a career in entomology. 9. An interest in entomology

Hugh V. Danks

This series of articles outlines some ancillary aspects of my entomological career, for the potential amusement of readers. It reports the sometimes unexpected challenges of working in new places and in the real world, an approach that serves also to expose some conclusions about research activities and some information about insects and their environments. This article outlines how my interest in entomology developed, with some things learned along the way.

Before the work in Canada described in previous articles in this series, I was an amateur entomologist in England, then an undergraduate specializing in entomology, and finally a graduate student. This article considers the first of these phases, which led to my career in entomology.

I was attracted to natural history at an early age, but developed a detailed interest only after finding a used compound microscope on the back shelf of an old and gloomy secondhand shop in London. The instrument was sold to me cheaply, but was of excellent quality. Its high-power lenses allowed examination of protozoans and other tiny creatures, both alive and preserved, using slides, coverslips, and mounting media obtained from the venerable English supplier of microscope equipment, Flatters and Garnett.

The microscope was put to use especially to study protozoans, diatoms, crustaceans, water mites, and other denizens of freshwater from a pond in the grounds of Hampton Court Palace—although the organisms there appeared to be no different than in habitats on more common ground!

I also examined plant tissue sections, preparing them with an impressively solid and finely honed cutthroat razor. Reading a book about biological staining methods prompted me to obtain various reagents and stains that would improve the contrast in material viewed with the microscope. My special orders from the local chemist[1] were highly unusual, but fortunately took place well before concerns about potential terrorists who might have more sinister plans. For example, one purchase was picric acid solution, a bright yellow liquid used as a fixative and stain; but the dry acid is a powerful explosive. On my campus years later, a long-forgotten bottle of picric acid that had dried up and crystallized around the stopper was discovered in the back of a laboratory cupboard. Immediately, the whole building was evacuated until the bomb disposal unit could complete its work.

The school system emphasized a series of increasingly difficult age-related examinations that were used to screen more and more students out of the academic pathway. Such a system worked better for some personalities than for others, but I wanted to progress academically and was a keen student[2] ... although few of the required subjects seemed relevant to my interest in biology.

[1]Similar to a drugstore or pharmacy in North America.

Hugh Danks (hughdanks@yahoo.ca) retired in 2007 after many years as head of the Biological Survey of Canada. In that role, he helped to coordinate work on the composition and characteristics of the arthropod fauna of the country, and to summarize the results. In addition, his research studied cold-hardiness, diapause, and other adaptations to seasonality in northern regions.

English lessons paid full attention to spelling, and conveyed trite but useful mnemonics (e.g., "i before e, except after c"). Syntax, parts of speech, irregular verbs, and other elements of grammar were given priority too. Study of those patterns established my interest in language, and the tools to develop a style of writing that (usually!) was coherent. Mathematical instruction drilled in times tables and arithmetical techniques, facilitating rapid calculations and even quicker general checks. Basic algebra and trigonometry helped later with more advanced concepts, as well as with practical matters such as the design and construction of minor equipment, and the preparation of aqueous solutions. This structured approach to schooling is deemed unworthy by some modern educators, but learning core elements of the English language and of mathematics is still essential. It certainly helped my career.

A few classes had less impact on me. Early physics lessons treated magnetism and other topics, but the teacher's perjorative nickname was more memorable because I could not recall his real name when asked by another teacher. The textbook on inorganic chemistry was large and dense. It introduced the subject of heavy-metal toxicity by noting the signs of poisoning amongst 18th-century sailors on a vessel with a cargo of mercury, as reported by the ship's surgeon. Almost the only thing I remember from that hefty volume, apart from its dark blue cover, is a footnote to the story: "Ship's surgeons are invariably truthful."! It was just as well that I became an entomologist rather than a physicist or a chemist.

My interest in entomology was prompted by a book borrowed from the local library. *The Butterflies of the British Isles* (Figure 1) treated about 70 species, including known vagrants. This number of species was manageable and could be identified relatively easily by a beginning entomologist.

Totally isolated from other entomologists at first (and short of funds), I made many mistakes. For example, a few of my earliest specimens were mounted using dress-making pins with limited durability, excessive diameter, and incongruously large heads! However, studying the catalogue of Watkins and Doncaster[3], a firm that specialized in entomological supplies, allowed me to acquire proper entomological pins, entomological forceps, and other equipment. My kite net was finely made of brass and stained hardwood, and easily dismantled for portability (Figure 2); most modern equivalents are less elegant. Diligent searches

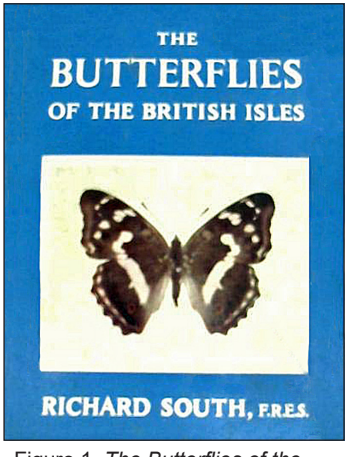

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Figure 1. *The Butterflies of the British Isles*, by Richard South (1943 edition).

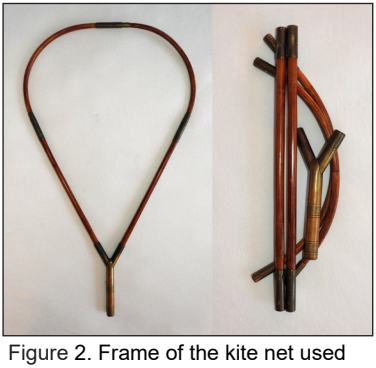

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Figure 2. Frame of the kite net used for the author's early collecting; L, assembled; R, dismantled. Length assembled, 71 cm.

[2]Fortunately, scholarships allowed me to attend a well regarded school (King's College School in Wimbledon), and then university, that otherwise would have been too costly.

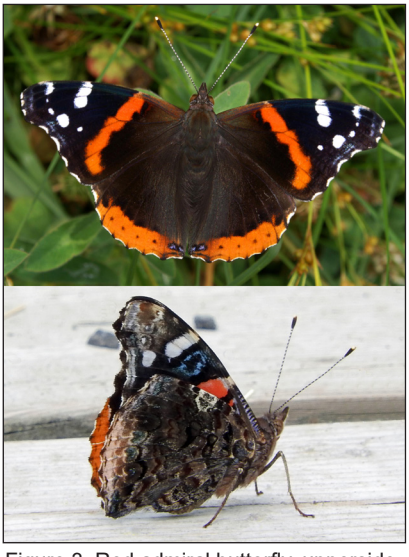
[3]Watkins and Doncaster, established in 1874, was run by Arthur Doncaster. He was completely deaf and speech impaired, communicating with customers through a slate, but he built up an extensive clientele. The firm still exists as a family business specializing in entomological equipment.

in secondhand-furniture shops eventually yielded an ancient but equally elegant mahogany insect cabinet with multiple drawers to house my specimens.

The firms that supplied my equipment for microscopy and entomology seemed locked in the Victorian era, which had ended 50 years earlier. Their letters were composed in an old and highly formal style and produced on well worn manual typewriters; generous applications of white-out concealed the many errors. The address on one package read "HStanks½", suggesting that staff biologists with limited typing skills handled shipping too.

The insect fauna of suburban England was limited by the high density of houses. Nevertheless, garden plants supported many kinds of insects, including cabbage white butterflies and other pests. The long-lived adults of vanessine butterflies were often observed too, especially red admiral (Figure 3) and peacock butterflies. Males of those two species hold territories and monitor them from patrols or perches. This trait favours repeated observation, so the species appealed to me. Their larvae feed chiefly on stinging nettle, a common weed.

Habitats inaccessible to the public (e.g., Figure 4) supported these and additional species even in suburbia. Further species occurred in some parks and other public areas that had not been regimented into lawns and formal plantings. One of my favourite collecting sites (Figure 5) was a grassland habitat thronged with butterflies (e.g., Figure 6). Many years later the butterflies were



Kenneth Dwain Harrelson (CC BY-SA 3.0)

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Figure 3. Red admiral butterfly, upperside (top) and underside. Wingspan about 5 cm.

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Figure 4. A railway cut in England, which served to preserve habitats for some species of insects.

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Figure 5. Grassy area in Richmond Park, Surrey, once a site rich in satyrid [satyrine], lycaenid, and other butterflies.

much less common there, apparently from general declines in the fauna as well as changes in vegetation.

Such impacts were inevitable in a densely inhabited country[4], and I developed an interest in conservation. Some of my zeal was directed against the mindless collectors of variation within butterfly species, who sought to amass hundreds of "vars" of the rarest species for the sole purpose of possessing varieties that others did not.

In a wider conservation context, ecological relationships intrigued me. For example, I had collected at Box Hill (Figure 7), part of an extensive area of chalkland known as the North Downs. Two attractive butterfly species in this habitat were the chalkhill blue (Figure 8) and the adonis blue; larvae of both species feed on horseshoe vetch, a plant of dry chalk and limestone soils. As in many species of lycaenids, the caterpillars are protected by ants, which thrived among the short vegetation on the dry, sunny slopes favoured by the butterflies. In the 1950s, rabbit populations were devastated by the myxomatosis virus, and the short turf could not be maintained without their heavy grazing pressure. The habitats were now shaded and cooler, so that ant populations declined. In turn, the blue butterflies, their life cycles dependent on well insolated slopes and on the ants, became much less numerous too.

Ecological interactions and the impacts of humans were confirmed in other ways. Taxation in the United Kingdom included estate duty (inheritance tax, death duty, or capital transfer tax), which served to reduce the assets of some of the long-established wealthy families. The rate varied, but increased during the 1960s to take as much as 80% of the

Dlugos (CC BY-SA 2.0)

Donald Hobern (CC BY 2.0)

Figure 6. Small copper (top) and small heath butterflies. Wingspans about 3 cm.

Hugh Craddock (CC BY-SA 2.0)

Figure 7. Chalk downland at Box Hill, Surrey (shown in 2014).

Gail Hampshire (CC BY 2.0)

Figure 8. Chalkhill blue butterfly, male. Wingspan about 3.5 cm.

[4]Currently, six species of British butterflies are considered extinct.

largest holdings. A number of country estates had to be sold to settle debts from these levies, and therefore additional land became available for development. One unforeseen result was the local elimination of some habitat-specific arthropods, as long-undisturbed old-growth woodlands were replaced by housing.

My activities soon expanded to encompass moths. I stayed outside throughout twilight to allow my eyes to adapt fully to the diminishing light, and could see noctuids and other moths at dusk as they whirred above the plants. There is no substitute for spending significant time on detailed field observations to understand the species under study.

After a time I also ran a light trap every night in the family garden. It used a mercury-vapour lamp supplied by Watkins and Doncaster, but the rest of the trap was home-made. Some creativity was required to make a strong, sealed, and weatherproof structure with cheap materials (although egg cartons provided cost-free refuges inside it for captured moths). The device was effective, but by no means elegant.

Observation of moths as they flew to the trap reinforced my understanding of the need to watch carefully for nuances of behaviour, including differences among species in how they reacted to the light. Moreover, some individuals attracted overnight would rest near the trap without entering it, but depart as the day grew brighter. Therefore, I began to check the surrounding area before sunrise to prevent the loss of prized specimens, and would wake up at dawn (before 5 a.m. for most of the summer!) without the need for an alarm. This manipulation of my biological clock had an unexpected benefit: the next hour or two could be used to prepare for the examinations important for progress in school and admission to university, and subsequently to digest university course material.

Insects were reared as well as captured. Eggs of exotic silkmoths (Saturniidae) were available from entomological suppliers, and the species favoured by amateurs had acquired popular names. The first species I reared (Figure 9) was called the "the squeaking silkmoth" because when larvae are handled they force air through the spiracles with a loud squeak, evidently to deter predators.

Rearing silkmoths exposed me to many new facts. Most striking were changes in the appearance of successive instars in some species (e.g., Figure 10), and increases in size as newly hatched larvae grew to thousands of times the volume before pupation.

Figure 9. The first species of saturniid reared by the author, the squeaking silkmoth (*Rhodinia fugax*, native to Asia): final-instar larva (top), about 7 cm long; and adult, wingspan about 10 cm.

Figure 10. The striking difference in size and appearance among instars of a silkmoth (the robin moth, *Hyalophora cecropia*, native to North America [known there as the cecropia moth]): top to bottom, first-instar larva (length about 0.5 cm); large larva; and fully grown final-instar larva (length about 11 cm).

Most caterpillars thrive when left alone to feed as much as possible, but do less well when fussed over or "helped" to transfer to new leaves. However, a few species—reared successfully especially by amateurs!—seem to profit from such fussing, including the "robin moth" (the larva shown in Figure 10), named after the red body of the large adult. Caring for many kinds of larvae taught me to pay attention to detail, and to consult references widely to find out the best ways to proceed. Plants in the garden, especially the lilac bush and the plum tree, suffered greatly as leaves were harvested to feed my larvae. Perhaps this abuse was tolerated because it meant that I was not getting into worse mischief elsewhere!

The importance of correct foodplants became evident not only for some of the large saturniids, but also during my attempt to rear silkworms (*Bombyx mori*) on lettuce rather than mulberry leaves. This trick had been noted in amateur circles, but in fact the alternative foodplant was barely capable of supporting growth, resulting in slow development and poor survival to the adult. Even so, those rearings showed how larvae spin their cocoons of commercial silk.

Many silkmoths emerge as adults over a protracted period, even in the wild, so that a male and a female seldom coincided to allow me to produce a subsequent generation. Another particular pairing difficulty is etched in my memory. *A Silkmoth Rearer's Handbook*, published in 1956, summarized relevant information for the African species *Cirina forda* as follows: **"**Both sexes emerge just before equatorial nightfall (1830 hrs), and fly within 2 hours. Male is very swift and dies within 48 hours. It will batter its wings to stumps and break its antennae in bullet-like flight against solid objects. Female will pour out eggs at first dawn whether paired or not." Nevertheless, I learned later that even some seemingly intractable species of insects are "easy to rear" once precisely correct artificial diets or culture conditions have been determined by a long series of exacting trials.

Native caterpillars collected out of doors were also reared to the adult stage—together with a disturbing array of braconid, ichneumonid, and chalcidoid parasitoids that emerged from some of them instead. To house caterpillars found during travel, I constructed a portable rearing cage that would collapse to fit easily into a pocket. It was used especially during the family seaside vacation as an alternative to simply sitting on the beach! More than once it was needed at home after too many caterpillars had been collected. Even when there were many caterpillars, however, maintaining them amidst the faint perfume of damaged leaves was a good deal more pleasant than the comparable chores my school friends complained about: looking after large mammalian pets that were substantially less fragrant...

The portable cage was made from recycled materials, and although it was effective (like my home-made light trap) it too was relatively crude. The collapsed cage fitted into a tobacco tin, and this container had a hole in the lid so that in an emergency it could hold a foodplant upright in water. The cage was covered by material sewn from a lightweight net curtain, and supported by tension in lengths of expanding curtain wire[5] that could be hooped over and hooked together. Years later, camping tents with flexible internal supports became available; these sophisticated structures were made of advanced materials, but even so relied on the same principle as my humble contraption.

The behaviour of bees and wasps in the garden eventually prompted me to study aculeate Hymenoptera too. Overwintered queen bumble bees searched assiduously for nesting sites in spring. Later, their workers joined butterflies and other insects on the flowers of a buddleia bush (Figure 11), while bees that had consumed too much of the copious nectar buzzed drunkenly

[5]Expanding curtain wire consists of a continuous, flexible, tightly coiled spring (about 0.5 cm in diameter) with a plastic outer covering.

on the ground below. Smaller mostly solitary bees, such as species of *Andrena* and *Halictus*, visited a range of other flowers. Solitary wasps searched for aphid prey on the plum tree that provided food for my silkmoth larvae[6]. Ripe fruits on that tree were chewed by yellowjackets, which earlier had scraped fibres from the wooden fence posts to masticate into pulp for their nests. The best way to see the adults of many small aculeates and other insects proved to be quiet observation of suitable habitats (where insects might arrive near the observer), rather than a frantic search.

One of my projects as a schoolboy (cf. Figure 12) was a synoptic collection of insects. The project earned a book prize, and my choice was Imms' *General Textbook of Entomology*. The most recent edition (1957) had been fully revised by O.W. Richards and R.G. Davies. At the time, I had no idea that those entomologists would be two of my lecturers at university, and one would supervise my PhD.

I joined the Amateur Entomologists' Society (AES) and attended its annual exhibitions, which were consequential because many hundreds of amateur entomologists belonged to the society. I also submitted items for the AES Bulletin about conservation, the portable rearing cage, differences in size among larvae of the same cohort, and other subjects. An article on migratory flight tendencies in the small white butterfly, published in my final year at school (1962), might even qualify as "research": recording the flight directions of steadily flying individuals showed that the butterflies travelled mainly northward in June, but mainly southward after the beginning of August.

Given these pursuits, I decided to study entomology formally, and gained admission to the entomology department at Imperial College of the University of London, a setting recommended by friends of my parents. The next article in this series treats my period as an undergraduate there.

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Figure 11. Buddleia bush in an English garden, its flowers commonly visited by butterflies, bumble bees, syrphids, and other insects.

F. Woods

Figure 12. Author Hugh Danks, in a pose then in fashion among portrait photographers, when he was a 16-year-old amateur entomologist in England.

[6]In due course, my doctorate included work on aphid-hunting wasps.

Mothers don't always know best: female parasitoid wasps' host choice

Joanna Konopka

Insects use different sensory modalities to interact with their environment and guide a range of ecologically relevant behaviours. For many female insects, one of the most important decisions they make is selection of an oviposition site. This decision is crucial for the female as it determines her offspring's survival, and hence the female's fitness. One way to characterize female behaviour in regard to oviposition site selection is to invoke the preference-performance hypothesis. This hypothesis postulates that a female will choose an oviposition site (e.g., a host plant on which the offspring will feed after hatching) that is most suitable for her offspring's performance. This premise implies that "mother knows best" for her offspring and has been generally supported in the literature. However, it turns out that mothers might not always choose what is best for their progeny when it comes to parasitoids.

The relationship between female choice and offspring performance should be especially strong in cases where the offspring are physically constrained and are solely dependent on the resource selected by the female. Such a situation applies to immature parasitoid insects developing on or inside a specific host on/in which the female has oviposited. The immature parasitoid feeds only on the resource (host) that the female has selected and is imprisoned inside that host until it can complete development to emerge as an adult. This situation contrasts with immature stages of many herbivorous insects (e.g., Lepidoptera) that can move from the host plant which they hatch on to a more suitable one nearby, if needed. Hymenopteran parasitoids have extremely diverse life history strategies, for example, the way they consume and kill their hosts, the competitive interactions they engage in, and their ability to modify host physiology and behaviour. Yet, they have one thing in common: their success is highly dependent on the host-searching abilities of the adult female (Quicke 1997, Wajnberg and Colazza 2013). Those parasitoid females must deal with high variability and complexity of cues while foraging. Their host-searching ability is also influenced by several intrinsic (e.g., physiological stage of the female) and extrinsic (e.g., environmental conditions) factors (Figure 1). Despite these influences, female parasitoids are able to navigate towards a suitable host to maximize their progeny's chances for success. The beauty in all this is the balance in the ecosystem, due to the shared evolutionary history among all the interacting organisms.

This balance can be disrupted, causing a series of events with direct and indirect consequences (positive and/or negative) for all organisms involved. Such a situation occurs with the introduction of invasive species. Insects are frequent actors in such scenarios, often being the invasive species wreaking havoc in the native community (e.g., emerald ash borer and Asian longhorned beetle).

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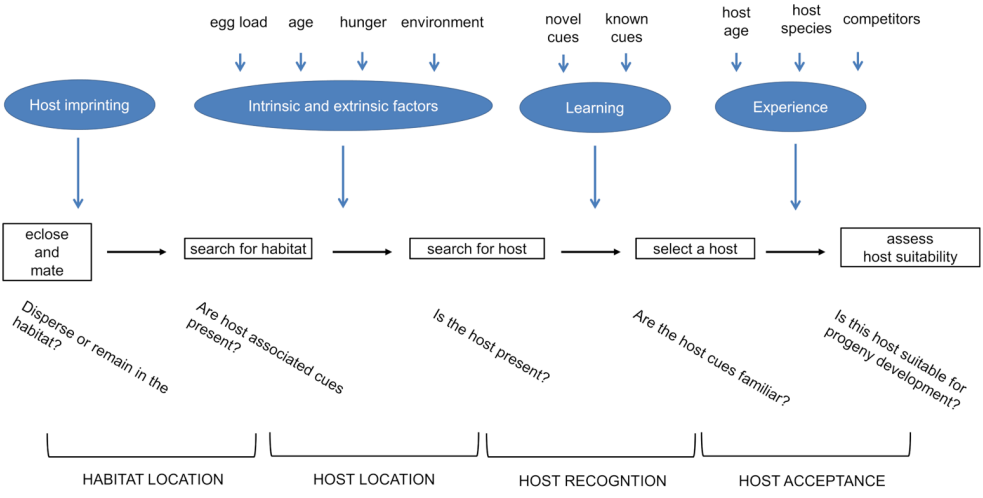

Figure 1. Schematic of a general host searching and acceptance behaviours of a foraging parasitoid female with selected factors that can influence it (Konopka 2018).

One insect regarded as one of the "most wanted" invasive species is the brown marmorated stink bug (BMSB; *Halyomorpha halys*). Native to east Asia and invasive in Europe and North America, BMSB is considered a serious nuisance and an agricultural pest causing multi-million dollar crop losses and damage. While from an economical perspective BMSB is a pest, ecologically it is just an organism exploiting abundant resources in the introduced area.

So, how is it all linked with the preference-performance hypothesis and oviposition? Some invasive species can have positive effects on the native community. BMSB is one such invasive species. It represents a new exploitable resource for parasitoids native to the introduced areas, if the parasitoids can locate and recognize it as a host. This is where the host-searching and preference-performance hypothesis comes in and where the story starts taking interesting twists and turns.

Here, the protagonists are egg parasitoids belonging to the family Scelionidae (genera *Telenomus* and *Trissolcus*). Like all parasitoids, they seek out hosts in which they can oviposit and in which their progeny can complete development, killing the host in the process (Figure 2). In this case, these hosts are eggs of other insects. Scelionids attack eggs of stink bugs, including those considered as pests. Therefore, I was interested in the possibility that the native parasitoids would attack BMSB eggs and provide some level of population control.

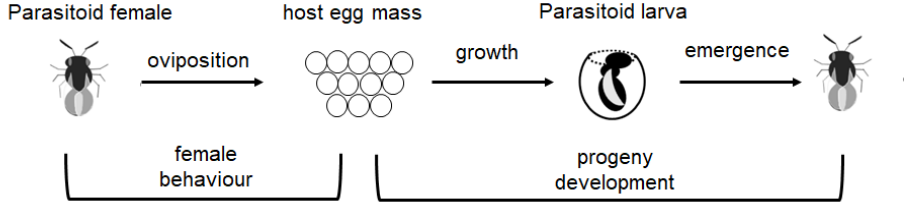

Figure 2. Schematic of host parasitization by adult female and progeny development inside the host.

The parasitism of BMSB by native parasitoids was reported to be low. It was unclear if this observation was due to females rejecting BMSB as a host, or due to the inability of the immature larvae to complete development inside this host. Molecular detection and comparison of parasitism under natural conditions in China (part of BMSB's native range), Switzerland, and Canada (part of BMSB's introduced range) revealed that parasitism was high and egg masses of BMSB were as attractive to parasitoids as those of the native stink bugs (Konopka et al. 2018a). Yet, very few parasitoids were able to successfully develop in and emerge from those field-parasitized egg masses. This finding confirmed that native parasitoids attacking BMSB are faced with an "evolutionary trap", indicating previously reliable cues were no longer indicative of an adaptive outcome (Schlaepfer et al. 2002, Abram et al. 2014).

This evidence indicated sufficient cues exist for native parasitoids to initiate parasitization of BMSB, but it was still unclear why parasitoid females would oviposit in a host unsuitable for their progeny. After all, "mother is supposed to know best" for her offspring. In fact, females were assessing host suitability using cues that were not that important for the progeny (Konopka et al. 2018b). There was a mismatch between the factors that females were paying most attention to (e.g., age of the host eggs) and the factors most likely to determine the success of the offspring (e.g., if the host eggs were previously parasitized or killed). In fact, the ranking of those factors was entirely reversed in some cases. Under such circumstances, the females were clearly "tricked" into making a significant investment (ovipositing), expecting a guaranteed return (progeny emergence), when in fact there was no guarantee at all.

F. Longpré

Figure 3. Egg masses of *Podisus maculiventris* (top) and *Halyomorpha halys* (bottom) stink bugs illustrating the relative size of the individual eggs (*P. maculiventris* ~0.8 mm across, *H. halys* ~ 1.3 mm across).

Up to this point, my work focused on the maladaptive choices of the females. However, another very important question was: why can't the larvae of the native parasitoids actually develop in BMSB eggs after females have successfully oviposited? We knew that females were ovipositing in BMSB eggs, but the progeny would almost never be able to complete development and emerge. Therefore, *in situ* visualization of the development of parasitoids inside the host eggs to determine the timing of the failed development in BMSB was the next logical approach.

The challenge was to come up with a way to visualize 1 mm long parasitoids in tiny insect eggs (Figure 3). Since we already had some experience imaging insects (Poinapen et al. 2017), we used X- ray micro-computed tomography to visualize in 3D, the events during parasitoid development inside the host (Konopka et al. 2020). This method works by taking X-ray images around the sample and reconstructing them into a 3D volume at a very fine resolution of 5.7 µm (approximately one seventeenth the thickness of a sheet of paper). Not only were we able to visualize normal host and parasitoid development *in situ* (Figure 4), but we also determined the timing

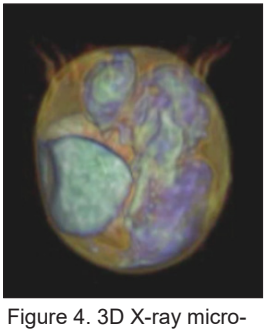

Figure 4. 3D X-ray micro-computed tomography volume reconstruction at 5.7 µm isotropic voxel spacing of a parasitized egg of *Podisus maculiventris* (a North American native stink bug) illustrating *in situ* parasitoid development inside a host egg approximately 2 weeks after parasitization. Colors are artificially added for contrast. For more images and videos of host and parasitoid development please refer to Konopka et al. (2020).

of failed development of native parasitoids in BMSB. We observed that most of the time North American native *Trissolcus cultratus* larvae could not survive beyond 24 hours post-oviposition in BMSB eggs. They either failed to hatch or died soon after hatching. This developmental study has enabled us to identify this crucial time window for further investigation of the mechanisms involved in preventing parasitoids from emerging.

Although these findings raised more questions, they improved our understanding of host-parasitoid interactions involving scelionid parasitoids. Systematic analysis of female parasitoid behaviour combined with studies of parasitoid competition (Konopka et al. 2017a, Konopka et al. 2017b) demonstrated the intricacies of ecological interactions among several organisms in this stink bug–parasitoid system. And when it comes to female parasitoid choice, she can be tricked into making a wrong choice. Although having the best of intentions, "mother might not always know best".

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eTick.ca: Engaging the public and increasing awareness of ticks and tick-borne diseases

Pierre Chuard and Jade Savage

The eTick project was initiated in 2014 by Professor Jade Savage, a biologist at Bishop's University, at a period when tick-borne diseases were of increasing concern to the Canadian population. eTick.ca is a citizen-science web platform that aims at monitoring tick populations in Canada and providing the public with information about tick-borne diseases in humans and domestic animals as well as details of the life history of the various species found in Canada. The public can submit pictures of ticks they have found directly on the website, and after identification of the specimen by trained personnel, the submitter receives an email with information tailored to their province of residence and the tick species they encountered. In addition, their submission appears directly as a dot on a public map upon validation (Figure 1). The eTick.ca platform was inspired by other initiatives such as eButterfly and its first pilot (2014-2016) was made possible due to the support of Bishop's University, the Public Health Agency of Canada (PHAC), and the

Figure 1. Workflow depicting the steps to follow to get a tick identified and posted on eTick.ca

Pierre Chuard (pchuard@ubishops.ca) obtained his PhD in behavioural ecology from Concordia University, Montreal, in 2017. He currently works as a research associate in the laboratory of Professor Jade Savage at Bishop's University. He is the project coordinator of eTick.ca, a web platform identifying ticks using pictures submitted by the public to better monitor tick populations in Canada. In collaboration with public health officials, they aim at improving prevention and awareness of vector-borne pathogen exposure. Pierre is also a contract faculty member at the same university where he teaches in the Department of Biological Sciences. Jade Savage (jsavage@ubishops.ca) is a full professor and has been teaching and conducting research in the field of entomology since 2004. An important part of her research program is dedicated to the development and dissemination of arthropod identification tools accessible to non-experts, especially for groups of medical or agricultural relevance.

Laboratoire de santé publique du Québec (LSPQ). The idea was to test if images taken by the public (veterinarians in the case of the first pilot) were sufficient to identify tick species. Results from the original pilot indicated that most ticks could be identified with high accuracy when images were of high quality, and that the eTick.ca platform was easy to navigate (Koffi et al. 2017). In 2017, the eTick identification services were opened to Quebec residents for ticks found on animals or free in the environment. Following a successful collaboration with the LSPQ to draft messages of public-health relevance to be sent to submitters upon successful identification of their tick, the final phase of the project allowed pictures of ticks found on humans to be submitted onto eTick.ca. The addition of ticks of human origin to the pilot project allowed Professor Savage and her collaborators to obtain funds from the Infectious Diseases and Climate Change Fund of PHAC to modernize the website, expand the project to New Brunswick and Ontario, and launch a mobile application that would facilitate submissions.

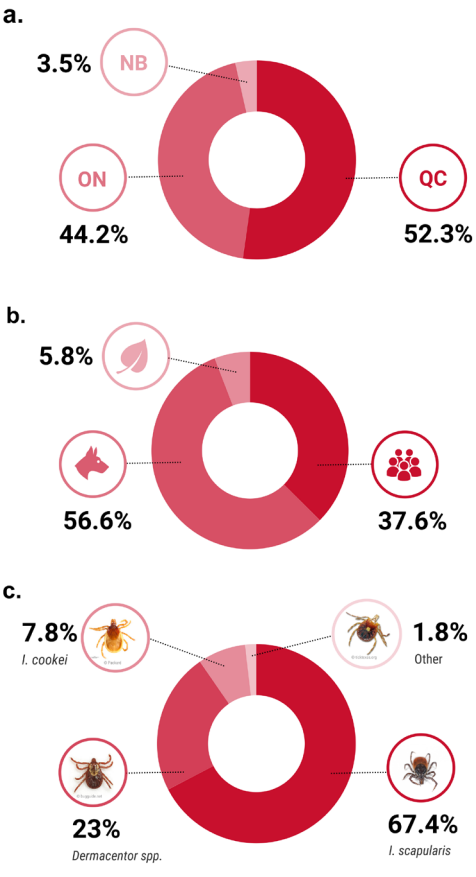

Figure 2. Proportion of valid submissions on eTick.ca for the year 2019 by (a) province, (b) host, and (c) species.

After a successful 2019 tick season in all three provinces, we compiled a total of 1345 valid submissions (including 91 from Pet Tick Tracker, a University of Guelph initiative and collaborator of eTick). Fifty-two percent of those valid submissions were from Quebec, 44% from Ontario, and 4% from New Brunswick (Figure 2a). When these numbers were corrected for province population, Quebec received the most submissions per capita and Ontario received the least. Most ticks were found on animals (56%), followed by humans (38%), and the remaining specimens were found free in the environment (6%; Figure 2b). The most commonly submitted tick species (67% of all submissions; Figure 2c) was the black-legged tick (*Ixodes scapularis*; Figure 3), the species involved in the transmission of the Lyme disease bacteria in these three provinces. Other common taxa were *Dermacentor* spp. (23% of submissions when combining the winter tick, *D. albipictus,* and the American dog tick, *D. variabilis*, which are indistinguishable based solely on pictures); and the groundhog tick (*I. cookei*; 8%). Other tick species represented about 2% of validated submissions.

Like most citizen-science projects, the success of eTick is best reflected by the number of people interacting with the platform. In 2019 eTick was promoted across all three provinces using both traditional and social media. As the website also provides an interactive map displaying

Figure 3. A black-legged tick questing for its next host.

valid submissions and other tick-related information, it is of interest not only to people that found a tick but also for those wanting to know more about tick presence in their area. We had particularly high numbers of visitors when we launched our revamped interface in April 2019 and when popular media outlets wrote articles about the project (Figure 4). Activities on the platform were multiplied by 12 from April to November 2019 compared to the same period in 2018, when activities were already increasing due to the announcement of the expansion to more provinces. eTick is also present on social media and the platform posts and tweets contributed to reaching out to more people and targeting an audience that is more likely to be exposed to ticks. The public actively engages, shares, and responds to our social media publications.

To improve the user experience and allow quick, on-site tick picture submissions, we will be launching the eTick mobile application in spring 2020. Due to the success of the first year of expansion, eTick was recently funded to expand to all of Canada. The platform will be available in Saskatchewan, Manitoba, Nova Scotia and Newfoundland and Labrador as of spring 2020, and other provinces and territories will be added in 2021. As eTick becomes a national project, its data will be comparable across provinces and territories thereby complementing various other provincial and federal tick surveillance programs. The project will be continuously updated to improve its content, especially for citizens that might simply be looking for more information on ticks in Canada. eTick.ca will be populated with general and province-specific content dealing with public health, animal health, and facts about ticks to increase awareness and prevention of tick-borne diseases.

Since the eTick.ca platform collects data about all tick species, it is also a surveillance tool to monitor the presence in Canada of exotic tick species of public-health relevance, such as the lone star tick (*Amblyomma americanum*) whose bite might lead to red meat allergies, or the Asian longhorned tick (*Haemaphysalis longicornis*) known to be an effective vector of a deadly virus in Asia. Finally, the large amount of data expected to be collected through this initiative could eventually be used by interested researchers to investigate questions related to different fields, ranging from public health to population ecology.

And don't forget, if you find a tick during your field work or any other activities, submit your pictures on eTick.ca!

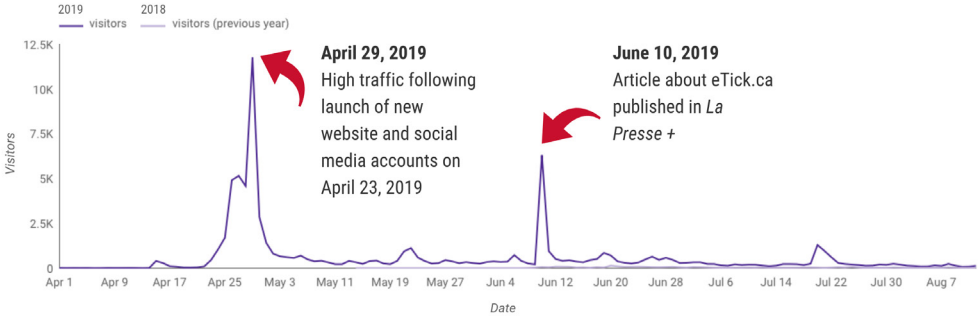

Figure 4. Number of visitors on eTick.ca between 1 April and 14 August 2019

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Citizen science in the Credit River Watershed: the 2019 Butterfly Blitz

Laura Timms

Introduction

Last summer, Credit Valley Conservation (CVC) hosted our first annual Butterfly Blitz – a citizen science program where participants learned how to observe and identify butterflies and then contributed data to a watershed-wide inventory. I wanted to share a summary of this project with ESC members, both to spread the news and to say thank you to the ESC and ESO for providing us with an outreach grant to help support our work.

CVC is one of 36 conservation authorities in Ontario; our head office is located in north Mississauga, just west of Toronto. Conservation authorities are organized based on the natural unit of watersheds, and our mandate is to protect and manage the natural resources within those areas. CVC's jurisdiction is the Credit River Watershed, running from Orangeville in the north to Port Credit in the south.

L. Chung

Lindsey Jennings from CVC looks at a butterfly caught during the August wrap-up event at Terra Cotta Conservation Area.

CVC has been running a water-focused citizen science program since 2011 and wanted to do something different in 2019. It was easy to convince our outreach team that a butterfly-focused project was the way to go for our next citizen science program. The publicity focused on insect declines in the past year or so has allowed me to start many discussions about insect conservation and to highlight the major need for data on many insect groups. The general appeal of butterflies to the public, the relative ease of their identification, and the established community of butterfly enthusiasts were also important factors.

Goals of the Butterfly Blitz

We had two main goals for the Butterfly Blitz: (1) to collect high-quality data on an understudied taxon; and, (2) to connect people with nature.

Creating connections between people and nature is a key part of CVC's mission. We believe that the most powerful force for environmental protection is an informed and mobilized community. Connecting people with nature is the first step in demonstrating how a thriving environment is vital for their health, safety and well-being. Those connections build capacity and advocacy for our work in the community. Citizen science programs like the Butterfly Blitz provide the

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Laura Timms (laura.timms@cvc.ca) is an ecologist at Credit Valley Conservation, where she has worked since 2013. She has an MScF (2005) and PhD (2010) from the University of Toronto. She has broad interests in biodiversity, conservation, parasitoids, the ecology of invasive species, and the history of science. She is currently the Chair of the ESC's Science Policy committee. Laura never thought she'd be interested in butterflies, but here we are.

opportunity to increase ecological literacy through experiential learning and the sharing of knowledge.

Despite being one of the most appreciated insect groups, butterflies have been the focus of very few targeted surveys in the Credit River Watershed, and local data on the group is sparse and uneven. This includes both CVC's data, which is mostly from incidental reports made by staff doing other work, as well as data from other sources. For example, the watershed includes 20 grid squares from the Ontario Butterfly Atlas; before 2019, over half (11) of those grid squares had no records of 60 or more of the around 100 butterfly species that could possibly be found there. In addition, before 2019 there had never been a North American Butterfly Association (NABA) one-day butterfly count in the watershed.

Program structure

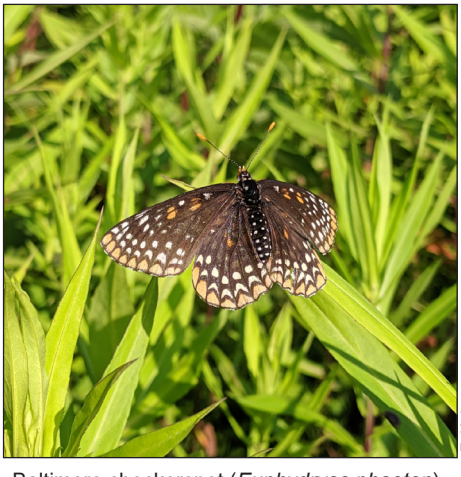
The 2019 Butterfly Blitz was designed as a summer-long program, so that participants could make observations on their own time between 22 June and 24 August. We offered three ways to contribute to the program: by uploading butterfly photos to the online platform iNaturalist; by conducting timed surveys and submitting them to eButterfly; and, by taking part in a one-day butterfly count at the end of June. Our registration process allowed people to identify which of the various activities they wanted to take part in, with commitment levels from low to high.

Participants were asked to register for the program on the CVC website; everyone who registered was invited to take part in a kick-off event in June. We provided hands-on training and materials at the kick-off event, covering such topics as where and when to find butterflies and how to use iNaturalist. Everyone involved with the program received a fold-out identification guide, and a subset of participants received butterfly nets. We also provided several other resources, including maps of areas with the highest data needs, two free passes to our conservation areas, and a guide to creating pollinator gardens.

We created an iNaturalist project for the Butterfly Blitz, which automatically included every butterfly observation made within the boundaries of the Credit River watershed during our set

L. Timms

Dion skipper (*Euphyes dion*), observed 23 July 2019 at Island Lake Conservation Area, Ontario.



Z. Kahn

Baltimore checkerspot (*Euphydryas phaeton*), observed 25 July 2019 near Georgetown, Ontario.

dates – whether or not the observer knew that they were participating in a Butterfly Blitz. We engaged with participants on iNaturalist throughout the summer by writing "observation of the week" posts, providing identifications and comments on butterfly observations, and by using the built-in leaderboard features to promote competition.

Those who wanted to submit data to eButterfly were asked to complete a minimum of four, 15-minute timed butterfly surveys. The observations in these surveys included the abundance of each species observed, and pictures were not required.

D. Schuurman

Acadian hairstreak (*Satyrium acadica*), observed 20 July 2019 in Caledon Creek Forest, Ontario.

Finally, a one-day butterfly count was held on 29 June. The count was run according to NABA guidelines; observations were made at sites within a 15-mile diameter circle centred on Belfountain Conservation Area. Data from the count were submitted to NABA.

I also led several butterfly-focused field days for CVC staff during the summer. We targeted areas with low numbers of observed species in the Ontario Butterfly Atlas. While not technically citizen science, this type of peer-to-peer training is part of CVC's culture of staff learning and development. Enabling CVC staff to find and identify butterflies increases our data collection capability, as staff visit various areas throughout the watershed in the course of their regular work.

We provided prizes at a wrap-up event at the end of the summer, for categories including most observations, most species observed, and rarest species observed. In addition to prizes, our wrap-up event included a group hike and one final butterfly survey for the project. Finally, we asked participants to provide feedback on their experiences via a survey.

Results & Discussion

Using all three observation methods, participants in the 2019 Butterfly Blitz observed 2755 individual butterflies from 56 species, or 60 species, subspecies, and hybrids (Table 1). The highest number of observations and species were seen using iNaturalist, followed by eButterfly, and then the one-day butterfly count.

iNaturalist: More than 100 people submitted 1,161 observations of 56 butterfly species to our iNaturalist project. The most commonly observed species were the monarch, red admiral, cabbage white, and black swallowtail. Seven species were observed only once or twice, including the mulberry wing and Acadian hairstreak. Five species were new iNaturalist records for the watershed, and one was a new record for CVC (Dion skipper). We observed one species of conservation concern, the provincially vulnerable black dash, which was found at a site where it had not previously been documented.

Of the 56 species observed, 44 of them (78% of species) had increases of more than 50% in the number of records from the watershed on iNaturalist during the project. For example, common wood nymph had 33 records in 2019, and 5 from all years before 2019; therefore, 87% of all records of this species from the watershed in iNaturalist are from 2019.

Table 1. Frequency of reports of butterflies in the 2019 Credit River Watershed Butterfly Blitz using three methods: uploaded photos to iNaturalist (iNat); one-day butterfly count (NABA); and timed surveys submitted to eButterfly

Family	Scientific name	Common name	iNat	NABA	eButterfly	TOTAL
Hesperiidae	*Anatrytone logan*	Delaware skipper	7	0	3	10
	Ancyloxypha numitor	Least skipper	21	1	6	28
	Carterocephalus palaemon	Arctic skipper	2	0	0	2
	Epargyreus clarus	Silver-spotted skipper	25	2	2	29
	Erynnis baptisiae	Wild indigo duskywing	6	0	0	6
	Erynnis juvenalis	Juvenal's duskywing	1	1	1	3
	Euphyes conspicua	Black dash	1	0	0	1
	Euphyes dion	Dion skipper	3	0	0	3
	Euphyes vestris	Dun skipper	21	0	13	34
	Poanes hobomok	Hobomok skipper	15	15	4	34
	Poanes massasoit	Mulberry wing	1	0	0	1
	Polites sp.	.	2	0	0	2
	Polites mystic	Long dash	3	1	0	4
	Polites origenes	Crossline skipper	1	0	0	1
	Polites peckius	Peck's skipper	37	3	2	42
	Polites themistocles	Tawny-edged skipper	7	2	3	12
	Pompeius verna	Little glassywing	8	0	6	14
	Thorybes pylades	Northern cloudywing	5	26	0	31
	Thymelicus lineola	European skipper	26	16	55	97
	Wallengrenia egeremet	Northern broken-dash	14	0	13	27
	Hesperiidae	.	1	0	0	1
	Hesperiinae	.	3	0	0	3
	Hesperiini	.	11	0	0	11
Lycaenidae	*Celastrina lucia*	Lucia azure	1	0	0	1
	Celastrina neglecta	Summer azure	0	5	0	5
	Celastrina sp.	.	11	0	2	13

...Continued

Table 1. Continued

Family	Scientific name	Common name	iNat	NABA	eButterfly	TOTAL
	Cupido comyntas	Eastern tailed-blue	21	2	5	28
	Glaucopsyche lygdamus	Silvery blue	10	38	8	56
	Satyrium acadica	Acadian hairstreak	2	0	0	2
	Satyrium calanus	Banded hairstreak	14	0	2	16
	Satyrium caryaevorus	Hickory hairstreak	4	0	2	6
	Satyrium liparops	Striped hairstreak	8	0	3	11
	Satyrium titus	Coral hairstreak	3	0	1	4
	Satyrium sp.	.	1	0	0	1
Nymphalidae	*Aglais milberti*	Milbert's tortoiseshell	10	1	6	17
	Cercyonis pegala	Common wood-nymph	36	0	67	103
	Coenonympha tullia	Common ringlet	30	83	25	138
	Danaus plexippus	Monarch	195	17	270	482
	Euphydryas phaeton	Baltimore checkerspot	4	0	0	4
	Lethe anthedon	Northern pearly-eye	24	1	104	129
	Lethe appalachia	Appalachian brown	5	0	0	5
	Lethe eurydice	Eyed brown	7	0	0	7
	Lethe sp.	.	1	0	0	1
	Limenitis archippus	Viceroy	18	0	10	28
	Limenitis arthemis	Red-spotted admiral	4	14	0	18
	Limenitis arthemis arthemis	White admiral	13	6	11	30
	Limenitis arthemis arthemis — astyanax	White admiral — red-spotted purple	3	1	0	4
	Limenitis arthemis astyanax	Red-spotted purple	12	6	11	29
	Megisto cymela	Little wood satyr	36	177	96	309
	Nymphalis antiopa	Mourning cloak	10	0	6	16
	Phyciodes cocyta	Northern crescent	33	34	61	128

...Continued

Table 1. Continued

Family	Scientific name	Common name	iNat	NABA	eButterfly	TOTAL
	Phyciodes tharos	Pearl crescent	10	0	18	28
	Phyciodes sp.	.	5	0	0	5
	Polygonia comma	Eastern comma	13	0	3	16
	Polygonia interrogationis	Question mark	22	0	2	24
	Polygonia progne	Grey comma	3	0	1	4
	Polygonia sp.	.	3	0	0	3
	Speyeria cybele	Great spangled fritillary	7	1	1	9
	Vanessa atalanta	Red admiral	106	0	41	147
	Vanessa cardui	Painted lady	15	0	1	16
	Vanessa virginiensis	American lady	31	0	4	35
	Vanessa sp.	.	1	0	0	1
Papilionidae	*Papilio canadensis — glaucus*	Canadian — eastern tiger swallowtail	15	0	8	23
	Papilio glaucus	Eastern tiger swallowtail	4	20	4	28
	Pterourus sp.	.	2	0	0	2
	Papilio cresphontes	Eastern giant swallowtail	2	0	4	6
	Papilio polyxenes	Black swallowtail	79	0	10	89
Pieridae	*Colias eurytheme*	Orange sulphur	7	0	0	7
	Colias philodice	Clouded sulphur	12	0	7	19
	Colias sp.	.	1	0	0	1
	Pieris oleracea	Mustard white	5	1	4	10
	Pieris rapae	Cabbage white	81	2	212	295
		TOTAL individuals	**1161**	**476**	**1118**	**2754**
		Number species	**55**	**23**	**41**	**56**
		Number species, subspecies, hybrids	**59**	**26**	**43**	**60**

The number of butterflies observed on iNaturalist in the Credit River Watershed during the Butterfly Blitz represented a 1351% increase from the same time period in 2018 (Table 2). Usage of iNaturalist has been increasing each year since its creation, so it is important to compare this change to that seen in other groups. The average increase in observations of other taxa in the watershed over the same time period was 144%. The number of people making butterfly observations increased by 261% from 2018 to 2019, compared to a 170% increase for observers of other taxa (Table 2).

The geographical spread of butterfly observations on iNaturalist in 2019 was much more complete than in 2018 (Figure 1). In particular, we saw significant increases near Orangeville,

Table 2. Percent change in the number of observations and users contributing those observations in the Credit River Watershed on iNaturalist between June 22nd and August 24th in 2018 and 2019

	Observations			Users		
Taxon	2018	2019	% change	2018	2019	% change
Butterflies	80	1161	1351.3	31	112	261.3
Coleoptera	60	178	196.7	15	79	426.7
Diptera	25	122	388.0	12	53	341.7
Hymenoptera	60	277	361.7	17	72	323.5
Odonata	52	223	328.9	26	48	84.6
Orthoptera	23	40	73.9	11	25	127.3
Moths	430	351	-18.7	.	.	.
Mammals	24	50	108.3	17	30	76.5
Amphibians	34	69	102.9	21	34	61.9
Reptiles	17	30	76.5	13	24	84.6
Birds	87	166	90.8	28	53	89.3
Plants	1455	2888	98.5	90	265	194.4
Fungi	352	84	-76.1	21	33	57.1

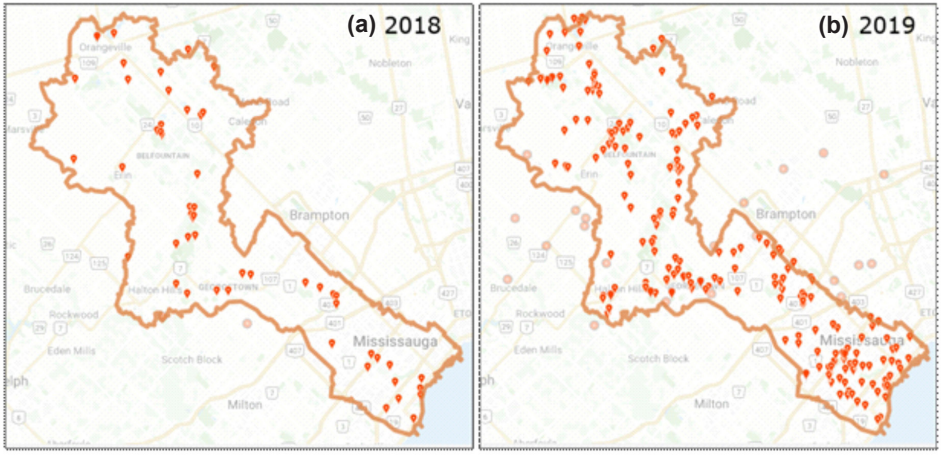


Figure 1. iNaturalist observations of butterflies from the Credit River Watershed between 22 June and 24 August 2018 (a) and 2019 (b). Each orange point represents one butterfly observation. Map from inaturalist.ca.

Acton, and Brampton – areas that we had identified as having low data coverage. Some places continued to receive very few observations, mainly areas with low natural land use.

One-day butterfly count: Eighteen participants in four groups visited nine different sites in the upper Credit River Watershed on 29 June. Together, the groups saw 476 individuals of 23 butterfly species. The most productive site was Forks of the Credit Provincial Park.

eButterfly surveys: Seven people submitted the results of 34 timed surveys to eButterfly. Over a total of 2567 minutes, these surveys observed 1118 individual butterflies from 41 species. The most common species observed in the timed surveys were slightly different from the common species from iNaturalist, highlighting the difference in results when abundance is recorded.

Participants: About half of the people who signed up for the program did not end up participating. Of the 59 people who registered, only 40 showed up to the kick-off event or let us know that they couldn't attend but planned to participate. Of those 40, 25 remained active throughout the summer. Conversely, 16 of the 41 active participants did not register ahead of time.

Of the three methods of participation in the Butterfly Blitz, iNaturalist was the most commonly used; 112 people submitted observations to the iNaturalist project. Of those 112 people, 27 were registered participants and/or frequent contributors (i.e. nine or more observations). It is worth noting that this group involved 15 professional biologists, including 12 CVC staff.

Each of the seven people who submitted timed surveys to eButterfly also participated using iNaturalist. Two people participated using all three platforms. The participants in the NABA butterfly count were less likely to also participate using other methods. Of the 18 people who came to the butterfly count, only four of them also used another platform to contribute data to the Butterfly Blitz.

Progress towards goals

The goal of data collection was certainly achieved in the first year of our Credit River Watershed Butterfly Blitz. We increased the number of the species documented from the watershed, the number of observations, and the geographical coverage of butterfly records. In addition, we documented new locations for butterflies not commonly seen in the area – including one provincially vulnerable species.

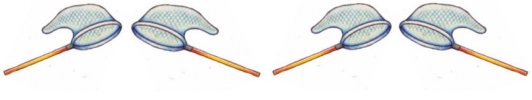
We also had some success in our goal of connecting people to nature, although not as definitively as the data collection goal. A large portion (39%) of the 41 active participants through the summer were CVC staff or professional biologists employed elsewhere. Many of the remaining participants were members of local naturalist clubs that are already relatively engaged with nature. However, we did reach a handful of people that were not previously engaged. In addition, we consider it an accomplishment that the Butterfly Blitz program resulted in an increase in the amount of time that all participants spent engaging with the insect fauna in the watershed. For example, over half of our participants (17/27 active iNaturalist users) also spent time documenting other insect groups – increasing the observation rate in those taxa.

Next steps

We will be repeating the Butterfly Blitz in 2020, and plan to make a few tweaks to the program based on our experience in 2019. We will make our registration process simpler, do more outreach to naturalist groups to encourage members to join our project, and add more guided hikes and opportunities for group activities throughout the summer. We have already begun our plans and can't wait till butterfly season is here again.

As it is repeated over time, the data collected through the Butterfly Blitz will provide insights to help protect and restore wildlife habitat in the Credit River Watershed. For example, the data will lead to a better understanding of local species distributions and site-specific assessments of butterfly diversity. In addition, we aim to assess the local conservation status of butterflies in the watershed and assign each species a local conservation status rank. The data will also benefit external programs, such as the Ontario Butterfly Atlas, and over time may allow for the assessment of trends in occupancy, phenology, and relative abundance.

If you're interested in learning more about the Butterfly Blitz or would like to know how to get involved next year, contact Laura Timms: laura.timms@cvc.ca, 905-670-1615 ext. 377.



Now tell us what you really think – again: Results of a survey of ESC members attending the 2019 ESC-CSEE-AES joint meeting

Chris MacQuarrie and Joanna Konopka

In August 2019 the Entomological Society of Canada (ESC) met in Fredericton, New Brunswick, with the Canadian Society for Ecology and Evolution (CSEE) and the Acadian Entomological Society (AES). Immediately following this conference, all ESC members received an emailed link to a survey. The 2019 survey was a slightly modified version of the survey used following the 2017 Joint Annual Meeting (JAM) (see MacQuarrie and Konopka 2018 for a summary of those results) and the 2018 JAM held in conjunction with the Entomological Societies of America and British Columbia. The 2019 survey solicited ESC members' opinions of the most-recent conference (for those ESC members who attended) and opinions about the JAM in general. The survey was available in both official languages.

The 2019 JAM survey was posted to the web on 22 August 2019 and members were notified by email, with a reminder sent on 30 September. The survey closed on 7 October. The survey was anonymous and no identifying information about the respondents was collected or solicited. However, respondents did have the option to leave free-form comments, which may contain personally identifying information.

The ESC Governing Board was provided with a full copy of the survey results with analysis provided by the Society's association management firm, Strauss. Copies of the responses for the 2017, 2018, and 2019 surveys can be obtained from the ESC Secretary.

A brief note on the terms used in this article. The ESC always holds its annual meeting jointly with one of the regional entomological societies. Within the ESC, the annual meeting is referred to colloquially as 'the JAM". For that reason, we use the term JAM throughout to refer to all meetings of the ESC, including the 2019 meeting in Fredericton that is the subject of this article. However, the 2019 meeting was denoted by the organizers as 'EcoEvoEnto" to reflect both the theme of the conference and the fact that it was a joint effort of the CSEE, AES and ESC.

One hundred and thirteen ESC members responded to the 2019 survey. This is consistent with the response rates to previous JAM surveys. Researchers and professors made up approximately 50% of the respondents. The next largest group were students or postdoctoral fellows (29%), with the remainder being retirees and members with other employment categories (e.g., not-for-profit, self-employed). Of the respondents, 15% identified as early career researchers. Most respondents (>75%) were employed at universities (53%) or by governments, and almost all respondents were from Canada (>90%). While most members who identified as student and early career researchers had attended a JAM or a meeting of one of the regional entomological societies in the past (92.1% and 64.9%, respectively), approximately half had never attended a CSEE meeting.

Most of the respondents to the survey attended the 2019 conference in Fredericton, but fully a third chose not to. When asked why they did not attend the JAM, the most commonly

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given answers were economic. The survey respondents either had insufficient funds to attend the meeting (30%) or found the cost to be too high (11%), although this is based on only 37 responses.

Somewhat paradoxically, of those that did travel to Fredericton most (75%) rated the meeting cost as 'average' relative to other conferences they had attended in the past year. Arriving at an affordable registration fee is a perennial challenge for JAM organizers. While most attendees had access to institutional funds or grants that they used to pay for their JAM attendance, almost a quarter of 2019 JAM attendees paid out of their own pocket. This includes 16% of attendees that paid the entire cost themselves. Ensuring that the cost of attending the JAM is reasonable is important to all ESC members, but to this cohort in particular.

This year marked the second use of a meeting code of conduct at a JAM. In 2018, the ESC adopted the Entomological Society of America's meeting code of conduct, to which all meeting attendees had to agree to at registration. In 2019, a joint code of conduct was developed by the CSEE, AES and ESC, and in 2020 an ESC code of conduct will be used. Of the members that attended the 2019 JAM, more than 75% did read the code of conduct and found it to be clear. However, this also means that almost a quarter of attendees did not read the code of conduct. Meeting codes of conduct, and the requirement to agree to abide by their conditions, are becoming a common feature of conferences. It would appear that ESC members are familiar with the ESC's code but there is still some work to do.

Attitudes towards the traditional meeting program appear to be changing, but slowly. Almost 40% of attendees indicated they would prefer to receive the program book in entirely digital form. Fifty-five percent of the respondents would prefer to have just the program component on paper, with abstracts available online. Only 9% would prefer a paper version of the entire program.

An important part of every JAM is the experience of student and early-career members. The most significant student event at each JAM is the Graduate Student Showcase (GSS). Most respondents to the survey were familiar with the GSS. Those not familiar with the GSS (19%) possibly represented first time ESC meeting attendees (20% of all survey respondents reported first time attendance to an ESC meeting). Approximately half of all students (52%) have never applied to GSS and a quarter expressed interest in applying to the GSS when they are closer to finishing their current degree. This suggests that interest in the GSS is strong but for the past 2 years scheduling issues have challenged the pride of place that the GSS has traditionally held. This has resulted in complaints from students and early career ESC members. To address this, a revision to the ESCs meeting organization guide will include specific instructions to future JAM organizers about how to schedule the GSS. The hope is that this will ensure that the GSS persists as an important part of the JAM.

The 2019 JAM also brought a number of notable 'firsts'. In addition to the code of conduct, the meeting featured pronoun stickers and on-site childcare options. A number of members commented positively on these innovations which hopefully will make a return at future meetings.

The 2019 JAM was also the first time in recent memory that the ESC meeting was held in the summer. The reception to this change from the regular fall meeting was decidedly mixed. Among those members that left comments on the survey, the reaction was generally negative, with many pointing out the (potential) disruption to field work. However, when asked, more than 40% of ESC members responded that they would be open to the ESC holding future meetings on university campuses to reduce costs; an option only available in the summer months. Only 20% of respondents were against summer meetings. Moreover, while more than 50% of respondents were in favour of keeping the meeting in the fall, a quarter were open to a meeting in the summer and 30% were indifferent. These results are somewhat confusing and even contradictory. They are, though, consistent with the trend where ESC members have said minimizing the JAM's cost

should be the most important criterion in selecting a meeting location. One perhaps relevant historical note is that prior to the 1980s the ESC did hold meetings in the summer and on university campuses. It is also worth noting many other organizations hold conferences in the summer. Perhaps it is time to consider a return to this practice.

While on the whole attendees rated the conference organization and content very highly and on-par with previous meetings, there is some room for improvement. That is to say, there were a few things that members didn't like and among those that left comments, a few common themes emerged. ESC members would like our significant events – the Gold Medal Address, Heritage Lecture, and GSS – to not appear in concurrent sessions. That is abundantly clear. ESC members also commented on an apparent lack on integration between the three societies, reflected in the program and conference events. This is a challenge in meeting with multiple large societies each with its own agenda and traditions. It is also clear from the comments we received that attendees and prospective attendees want detailed information about meeting events, and what is – and is not – covered in their registration fee. These are all very good suggestions that future meeting organizers should be aware of.

The 2019 JAM closed a 2-year run of the ESC meeting jointly with other, larger societies. This brief foray into large meetings follows a 17-year period where we met alone. Most respondents think joint meetings are a benefit to the Society and a positive thing in general. However, it also appears that after this period of large, integrated joint meetings we are ready for a return to the regular JAM format this fall in Calgary. One consideration though is that meeting jointly with other large societies allows the ESC to provide amenities that it may otherwise not be able to offer in its typical, small meeting. Joint meetings with large societies may also be an option to reduce the costs of travel – both economic and environmental – that are becoming increasingly important. The character and content of the ESC may be lost when we meet with other large societies, but more frequent joint meetings with them may be something that the ESC will need to consider.

In 2020 and 2021 the ESC will meet in Alberta and Ontario in what might be called 'traditional' JAMs. However, as long-time attendees of JAMs (a total of 25 between the two of us) it's fair to say that we've observed that each JAM has its own unique character. This character is a reflection of the organizers, the hosting society and the attendees. A strength of the ESC is that its annual meeting reflects the people and the country it represents. It is important that in all future meetings that we retain this character but we must also be open to change. Doing so will leave the Society, and its annual meeting, stronger and better able to represent entomological science in Canada.

Acknowledgements

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MacQuarrie, C.J.K., and Konopka, J. 2018. Now tell us what you really think – results of a survey of members and JAM participants. Bulletin of the Entomological Society of Canada, **50**: 70-74.

Oppiella nova (Oudemans, 1902): not an insect, but just as cool

Carlos Barreto

C. Barreto

Individuals of *Oppiella nova* under compound microscope (top) and stereomicroscope (bottom).

Hosts/Food Source: *Oppiella nova* (Oudemans, 1902) (Sarcoptiformes, Oribatida, Oppiidae) is a free-living oribatid mite, not associated with any host organism. However, *O. nova* itself can host endosymbionts like *Wolbachia* (Konecka and Olszanowski 2015). Individuals of *O. nova* mainly feed on fungal hyphae (Ponge 1991), but they can also be microphytophages or fragment feeders (Kaneko 1988), and less commonly feed on living and dead animals like nematodes and collembolans (Schneider et al. 2004).

Habitat: The mite has been collected from a range of habitats including mosses (Lindo 2015), wood litter (Abbott et al. 1980), plant litter (Barreto and Lindo 2018), lichens (Lindo and Stevenson 2007), salty mine water (Skubała and Madej 1998) and lakes (Niemi 1985).

Geographic Range: *Oppiella nova* is considered a cosmopolitan species, with records for South America (Oliveira et al. 2017), Central America (Schatz 2006), North America (Marshall et al. 1987), Asia (Chen et al. 2010), Europe (Lundqvist 1987), Oceania (Collof and Halliday 1998) and Africa (Ermilov et al. 2017). To the best of my knowledge, the species has not been found in Antarctica (but see Starý and Block 1998).

Natural History: Originally described from Rotterdam (Netherlands) as *Eremaeus novus* Oudemans, 1902 (van der Hammen 1952) and combined with *Oppia nova* (Oudemans, 1902) (van der Hammen 1952), *Oppiella nova* is one of my favourite species. Its body length varies between 231 and 297µm (Von Saltzwedel et al. 2014), which is basically shorter than the diameter of two human hairs side-by-side. A tiny and weakly-sclerotized species like this would be an easy prey for predatory mites in soils. However, their small size provides them an advantage too; *O. nova* is highly mobile and can colonize pore space that is not large enough for their predators to move through, ultimately reducing the top-down control by the predators (Von Saltzwedel et al. 2014). This is an amazing survival strategy.

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Oppiella nova is one of the most studied oribatid mites in the world (Marshall et al. 1987), likely due to its cosmopolitan nature. I have found *O. nova* in my field sites in northern Ontario, Minnesota (USA) and Berlin (Germany) across different types of experimental treatments, both in the field and in lab experiments: warming, enhanced atmospheric CO_2, addition of microplastics, addition of fertilizers and even addition of predators. Moreover, this species was present in all types of soils I have sampled so far, from peatlands and boreal forests in North America to a meadow in an urban area in Germany.

One of the reasons *O. nova* is so common and abundant is perhaps because it is a thelytokous species (parthenogenetic) (Kaneko 1988), asexually reproducing, but also iteroparous (reproducing several times), in addition to being long-lived. In a laboratory study, *O. nova*'s entire life cycle, from eggs to adults, took only 23 days at 25°C (Woodring and Cook 1962). This reproductive strategy allows the species to grow to high numbers, making *O. nova* perhaps the most common and widespread arthropod in terrestrial environments (Norton and Palmer 1991).

Oppiella nova is also a good representative of the other life history attributes generally present in oribatid mites. They have low metabolic rates, which enable them to survive when food resources are limited (of low-quality) (Norton 1994). They have mortality concentrated in immature instars and little density fluctuation from year to year. All those life-history traits, together with their generalized feeding behaviour and adaptation to different environments, make *O. nova* a really cool species, but I might be biased for finding the whole Oribatida group incredible!

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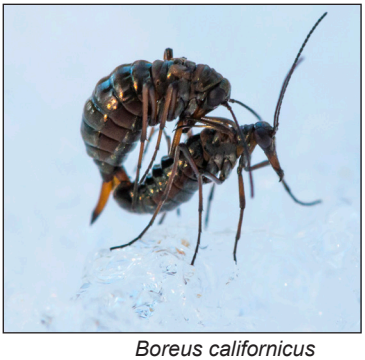
Boreus elegans Carpenter
Rob Cannings

The Boreidae (from the Greek "Boreas" -- the North Wind, the North) or snow scorpionflies are small, flightless mecopterans that resemble minute grasshoppers. The Holarctic genus *Boreus*, one of two known in the family in British Columbia (the other is the rare *Caurinus*), was chosen to represent the province for several reasons. British Columbia is a province of mountains and snow, the characteristic habitat of these insects. They are distinctive, with interesting and unusual behaviour. Five of the seven known Canadian species live in the province.



R. Lalonde

Boreus californicus

This is a slightly modified and updated version of an article in the inaugural issue of Boreus*, written by the Editor, Rob Cannings (rcannings@royalbcmuseum.bc.ca). Rob is Curator Emeritus of Entomology at the Royal British Columbia Museum in Victoria, where he was Curator from 1980 to 2013. Rob's research interests focus on insect systematics and faunistics, especially in the Odonata and Asilidae (Diptera), but he publishes widely on many insect groups. He has a strong interest in popularizing insects and insect identification through handbooks, keys and the internet. In former lives, Rob worked as a biologist and nature interpreter for British Columbia Parks and the Canadian Wildlife Service and was a lecturer and museum curator at the University of British Columbia. He served the Entomological Society of British Columbia in several capacities, including President (1986, 2001) and Regional Director to the ESC (1983-86). He started the newsletter* Boreus *in April 1981 and was Editor until 1991.*

Boreus elegans is the most distinctive of the British Columbia snow scorpionflies. It is considerably larger and redder in colour than the other four species of *Boreus*; as its name suggests, it is considered by some as the most striking of the genus. In Canada it occurs only in British Columbia. Although it is not distributed as widely in the province as some of the other species (e.g., *B. californicus, B. pilosus, B. reductus*), it inhabits the Coast Range and lives among the mountains by the sea, the two features most often associated with our province (and now linked with the image of *Boreus* on the ESBC seal).

Boreus adults are dark, long-legged insects that appear in the fall and winter. They are often found hopping and walking on the surface of the snow, where they are conspicuous because of their unusual movement and contrasting colour. The male has vestigial, bristle-like wings with which he grasps the female during mating. In the female, the wings are further reduced to small scales. The female has a long and conspicuous ovipositor.

The larvae are C-shaped grubs with a well-developed head capsule and three pairs of thoracic legs. They live among the moss and clubmoss plants on which they feed.

At the ESBC executive meeting on 27 November 1980, those present chose the genus *Boreus* (Mecoptera: Boreidae) to represent the Society on a new logo. Dr Cannings was given the task of recommending a particular species of *Boreus* for this honour. His only instructions were: "Make sure you choose a good species…we don't want the Society's insect to end up as a forgotten synonym in a few years!" *Boreus elegans* Carpenter was the final choice as the Society's official insect. Cannings also illustrated the female of the species in silhouette as the Society's logo and printed it on the covers of the newsletter, suitably named *Boreus*. The logo was subsequently incorporated into the Society's seal by Cannings and Peter Belton.

The Society's Official Insect, a female *Boreus elegans* Carpenter in silhouette. Order: Mecoptera, the Scorpionflies and Hangingflies. Family: Boreidae, the Snow Scorpionflies. Illustrated by Rob Cannings, 1981.

Emerald on the Shield: *Cicindela denikei*

Robert E. Wrigley

L. de March

Figure 1. Laurentian tiger beetle (*Cicindela denikei*) in its natural habitat.

Back in the 1980s, during my Manitoba Museum investigations of species that might be at risk in the province, I was informed by my entomologist colleague Dr Bill Preston of a rare species of tiger beetle from the extreme southeastern corner of the province. Only a few specimens of the Laurentian tiger beetle (*Cicindela denikei* Brown, 1934 (Coleoptera: Carabidae) were known from here. It also occurs in a small area of adjacent northwestern Ontario, in an isolated population on Manitoulin Island in Lake Huron (Bouchard et al. 2005, Jumean et al. 2017), and in adjacent northern Minnesota, where it was only discovered in 1958 (https://www.dnr.state.mn.us/rsg/profile.html?action=elementDetail&selectedElement=IICOL026M0). The Manitoba Government's Conservation Data Centre (Colin Murray, pers. comm.) rates this species as Vulnerable due to the few occurrences and small range. It was listed as Threatened in Minnesota in 1996 due to its limited range, but with several additional populations located recently, it has been changed to Special Concern (Ronald Huber, pers. comm.). The Ontario Natural Heritage Information Centre (Colin Jones, pers. comm.) and NatureServe Explorer (https://www.natureserve.org/) also list it as Vulnerable.

While most tiger beetles in North America are found in open areas with a substrate of sand, clay, or mud, the Laurentian tiger beetle is unusual in inhabiting exposed Precambrian Shield outcrops in spruce-pine-poplar forest – the kind of alvar landscape typical of the Whiteshell Provincial Park (Figures 1 and 2). Having never seen this species before, I was excited to join Bill on a trip to the park to determine if we could learn more about its distribution, life history, and ecology. We searched the rugged terrain for an hour without success, but still enjoyed the exhilarating hike and picturesque rock exposures, highlighted by reds, greys, blacks, and shiny crystals. All around the edges of the bedrock were bulging mats of green moss and patches of yellow and grey crustose lichens, punctuated here and there with depressions in the rock, which filled periodically with rain. Then, suddenly my eyes focussed on a spot of brilliant emerald green, and I

R. Wrigley

Figure 2. Habitat of the Laurentian tiger beetle.

Robert Wrigley (robertwrigley@mymts.net) is a retired ecologist and former curator/director of the Manitoba Museum (Winnipeg), Oak Hammock Marsh Interpretive Center (Stonewall), and Assiniboine Park Zoo (Winnipeg). He has pursued entomology as an amateur for 25 years.

quickly realized that it must be a Laurentian tiger beetle, watching me intently with its prominent black eyes. I whispered to Bill to come and see it, but with no sudden move that would for certain send our quarry to flight. Bill confirmed the identification, and then I began a cautious approach, keeping a low posture and turning my net sideways to reduce its profile. I felt like a cat stalking a mouse.

How close should I try to go? For I was told just how flighty these beetles can be? With my heart racing in excitement, I lunged and flipped my net over the beetle, careful not to allow its speedy escape from a tiniest opening under the rim. There it was, racing around inside the fabric at lightning speed. I managed to grasp it delicately in my fingers and then extracted my prize. Holding it at close range to my face for a better look, its impressive mandibles (Figure 3) repeatedly clenched in mid-air in an attempt to bite, and then it regurgitated some black liquid -- both defensive strategies. When I turned the beetle slightly, I was astonished to see the wing covers turn instantly from bright green to bright blue, a prime example of light refraction – the scattering of light waves bouncing off layers of the beetle's outer skeleton made of chitin (Figure 4). From that moment on, I was hooked on tiger beetles.

L. de March

Figure 3. A head-on, close-up view of the Laurentian tiger beetle is pretty impressive.

The Laurentian tiger beetle has been described as a 'summer' species, with adults present from May to August, but predominantly in late May to June. Certain other local species have two successive cohorts of adults active mainly in spring and fall. The life cycle usually takes two years, spent mostly in larval stages, and with adults living up to eight weeks. While usually rare and scattered, I have found the Laurentian tiger beetle relatively abundant on a few occasions, with over 100 observed within a hectare of prime habitat in Manitoba. I have also located individuals dispersing from alvars along open-forest trails with sand or gravel substrates, abandoned asphalt roads, as well as hills of exposed sandy glacial till. Northeast of Elma, Manitoba, lies the last small outcrop of the Shield where it descends under agricultural land, and I found two specimens inhabiting this isolated site. How often may one discover the exact current limit of a species' distribution? Dr Terry Galloway informed me that he observed a live Laurentian tiger beetle on a Winnipeg street, about 100 km west of the species' range. We assumed it must have been carried here on the grill of a car, since I have seen a few dead specimens struck by cars along roads within its range.

The Laurentian tiger beetle is considered a sister species of the six-spotted tiger beetle (*Cicindela sexguttata*), likely diverging during Late Pleistocene glacial periods (Kaulbars and Freitag 1993). *Cicindela denikei* averages slightly larger (13-15 mm) and has smaller and reduced numbers of white spots or maculations (or these are absent altogether) than *C. sexguttata* (personal observations). Larval burrows have been located under flat stones, and I have discovered both live and dead adults in such locations. It is impressive to watch this tiger beetle home in on insect prey (ants, beetles, flies, caterpillars, true bugs, etc.) in stop-start fashion. Using its large, rounded compound eyes, it tracks speedy prey like a guided missile and quickly dispatches its prize with its large, sharp mandibles. I don't believe I have ever spotted a Laurentian tiger beetle before it detected my approach. It either relies on immobility and camouflage (resembling a patch of green moss), or it takes flight and often vanishes against the background vegetation, whereupon it stops to watch my next move. As an individual nears the

edge of its home range, it sometimes passes right by me on its return flight.

This group of beetles, with 118 species in North America north of Mexico, and 2700 worldwide, has attracted the enthusiastic study by countless professional and amateur entomologists due to these insects' attractive appearance, charismatic behaviour, and ecological relationships. Much of what is known about these beetles has been discovered by amateurs, and it is rewarding to add my observations to entomological newsletters. It still gives me a thrill every time I see a tiger beetle, either watching me, running away, or taking flight, and I have to attempt to capture it just to confirm its identity. Although I have collected and acquired several thousand specimens of tiger beetles for museum donations and my research collection, I still enjoy releasing specimens and observing their antics. Observing a beetle rapidly excavate a temporary burrow, a male frantically attempting to mount and hold onto a reluctant running female, and an individual bouncing out of control on landing, always bring me a chuckle. As is the case with most diurnal tiger beetles, this is a species of bright sunlight, and cloudy weather often sends individuals under cover.

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Figure 4. Colour variations of the Laurentian tiger beetle due to refraction of light.

For additional information on tiger beetles, I recommend Acorn (2001), Pearson and Vogler (2001), Pearson et al. (2015), and the Cicindela journal (Huber et al.). Three colleagues and I are working on a paper on "The Tiger Beetles of Manitoba," which hopefully will encourage young naturalists into taking up the study of these charming little predators. My observation of that first Laurentian tiger beetle led me to undertake hundreds of subsequent field trips in pursuit of these and other kinds of beetles. Quite a remarkable gift bestowed by that little 'emerald on the Shield.'

Acknowledgments

Thanks to Larry de March for taking the beetle photos.

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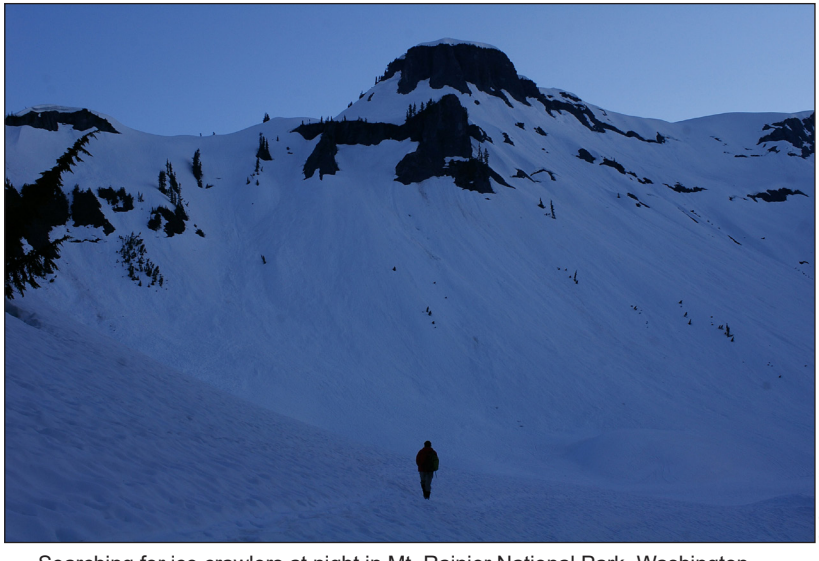
Insects on ice: *Gryllobatta*

Sean Schoville

S. Schoville

Adult male ice crawler, *Grylloblatta campodeiformis* Walker, from the type locality at Sulphur Mountain, Banff, Canada.

Twilight brings bone-cold air and a heavy silence to alpine landscapes. The cold rises from frozen lakes, out of deep drifts of snow, from the monoliths of granite, and from blue tongues of glacial ice. While the sky darkens, the ground glows from the pale luminescence of starlight on fields of snow. What scurries in the quiet starlight, on the snow?



S. Schoville

Searching for ice crawlers at night in Mt. Rainier National Park, Washington.

If you were to climb the talus slopes an hour after nightfall, you might encounter a cryophilic insect out foraging. Honey gold and cautious, ice crawlers climb out from gaps near rocks, first resting near the edge to sense the temperature, and then moving rapidly across the crisp snow to find frozen carcasses of windblown insects scattered across the mountain side. On a rare night you can find hundreds, glinting in the light of a headlamp, feeding in this strange frozen world. Often it is none, or one, or just a handfull of individuals; one can walk for hours to find them. Strange and mysterious, they retreat to great depths beneath the snow with the approaching dawn.

Sean Schoville (sean.schoville@wisc.edu) is an Associate Professor in the Department of Entomology at the University of Wisconsin-Madison. His research focuses on understanding how organisms evolve in response to environmental change, including how ice crawlers survive in cold environments and will respond to climate change.

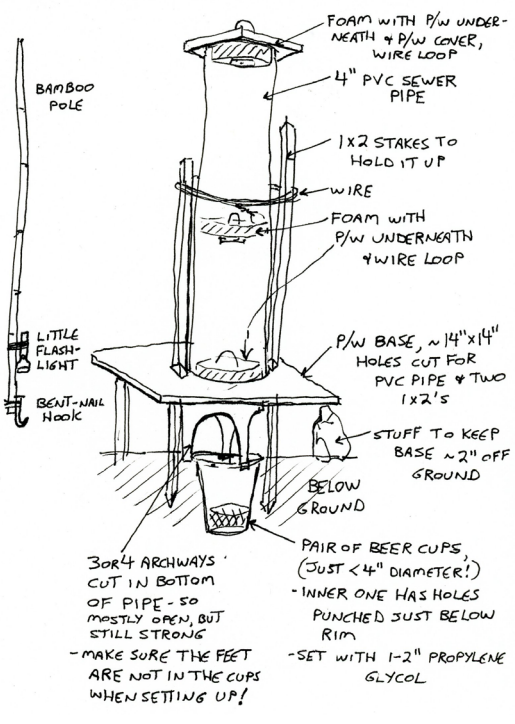
The unknown is easily misunderstood

Despite a bibliography that dates to their discovery in 1913, ice crawlers (Grylloblattodea: Grylloblattidae: *Gryllobatta*) remain an enigma and are exceedingly rare in entomological collections. Much remains to be learned about their basic biology, and to aid in this endeavor, certain myths need to be dispelled, starting with how they can be found.

My first knowledge of ice crawlers began with a brief account in the book *California Insects* by Powell and Hogue (1979). The description is only three short paragraphs, but one is immediately struck by the strange natural history of ice crawlers. The associated collecting notes were sparse, reading "cold, dark habitats such as under rocks, in decaying logs near receding snowbanks, and in ice caves." And "Almost all collections of grylloblattids are made between October and May…" I would spend the next several years trying to understand this description, searching for ice crawlers while mountaineering in the Sierra Nevada. I didn't have much luck.

In 2005, I found a single individual while walking across snow-covered talus at night near an alpine lake. It was late May in the Desolation Wilderness near Lake Tahoe, and a difficult time to venture into the mountains with the considerable snowpack. But it allowed me to form a search image: early summer, north-facing talus slopes around a frozen lake, and in the hours after dark. I found five that year, scattered across the Sierra Nevada. I felt like I had literally struck gold.

The years have passed, and my collections now number in the thousands. The search image is still valid, but considerably broadened as I have found ice crawlers in nearly every season of the year, at sea level and over 3500 metres, and, in some settings, without a trace of snow or ice in sight. In hindsight, looking across the diverse literature, this should have been more obvious. The first discovery, in Banff, happened in late summer, when collectors were digging in cool, rocky soil and unearthed several specimens. Others have found ice crawlers while spelunking in limestone caves and lava tubes, in the middle of a hot summer day. Other authors have reported turning over stones or logs in the fall, following the first frost, and finding ice crawlers just at the surface. Other accounts have reported seeing ice crawlers while snow-shoeing or skiing in the early evening in mid-winter. At many low elevation sites, they are likely to be active on the surface only in winter. For example, ice crawlers have been trapped in forested habitats, without a trace of talus, even when that forest has been logged or devastated by bark beetles (see Huggard and Klenner 2003; Esch et al. 2018). Of note are some innovative trapping techniques for winter sampling of ice crawlers, such as the "tree pitfall trap" (a pitfall tied to a tree trunk, as the heat of the tree often provides a tunnel to the surface that ice crawlers will use), and Huggard's chimney trap for sampling below the snow base.



Schematic of David Huggard's chimney trap, drawn by David Huggard.

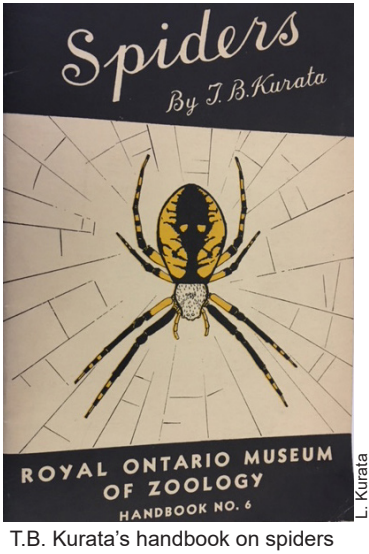
Stitching this strange variety of conditions together paints a picture of an insect that may not be as rare as often presumed. The common environmental conditions suggest that they are restricted to cool temperatures and high humidity, they prefer rocky substrates, and although they are active throughout the year, the only surface activity occurs when conditions are near freezing. Ice crawlers are strongly photophobic, avoiding daylight (or flashlight) by retreating to subterranean microenvironments. Less obvious is that efforts to collect them will vary with latitude. I have yet to find one by turning rocks in California, unless those rocks are under snow. By contrast, digging out stones from soil in cooler seasons can turn up ice crawlers in Canada, without a trace of snow.

History of Discovery in Canada

Among the many stories of ice crawlers, one I find more notable is the nature of the original discovery. As it happens, there is a forgotten hero in the tale, one worthy of some attention. On 29 June 1913, on route by train to Vancouver Island for the Royal Ontario Museum, two scientists stepped off to collect some insects in Banff (the tale, and quotes to follow, can be found in Hutchinson (2014). By fluke of luck, they boarded a bus to lodgings at the Upper Hot Springs, midway up the slope of Sulphur Mountain. Heading to the top on an excursion, the two men searched for insects. Lo and behold, "… Kurata called me to see an insect he had found under a stone… I knew at once that this creature was something new – unlike anything ever found before." Edmund M. Walker (1877-1969), quoted here, would go on to describe the first ice crawler species (and family, and order), and make significant additional contributions to the field of entomology throughout his career. But I'd like to note that the search image and collecting effort that led to the discovery of the first ice crawler was that of T.B. Kurata.

Takatsuna Bailey Kurata (1880-1962), a Japanese immigrant from Nagano, Japan, first moved to Coe College in Iowa to study ornithology (the name Bailey was taken from Bert Heald Bailey, his mentor, in a custom to honor him following Bailey's early death in 1917). In 1911, T.B. took a position at the University of Toronto, moving permanently to Canada. In 1912, he became the first full time employee (a "preparatory") at the brand-new Royal Ontario Museum. You might ask, how would an ornithologist find the first ice crawler (wouldn't he be looking up)? In fact, it was an interest in arachnids that led him to look down and turn stones on the side of Sulphur Mountain. Over the course of his career, T.B. would contribute more than 60,000 arachnid specimens to the museum, and would author its handbook on Canadian spiders.

T.B. was employed to do a variety of natural history collecting and specimen preparation for the museum. According to his son Lucien "Luke" Kurata (who kindly corresponded with me), "T. B. was a generalist and did much in entomology, arachnology, and ichthyology." Indeed, some of his most significant work was as an artistically talented museum scientist, where he developed many of the modern techniques used to preserve dried fish, reptile and amphibian specimens. As Luke notes, "Although he has never been credited for his efforts, he pioneered fin and scale counts in fish taxonomy and the process of casting fish and doing anatomically correct skin and scale presentation on the castings. He was the last taxonomist that had the opportunity to work with the giant sturgeon of Lake Huron and Georgian Bay."



L. Kurata

T.B. Kurata's handbook on spiders for the Royal Ontario Museum series.

T.B. is an unsung hero in the field of entomology, but also served Canada proudly. As Luke wrote, "At the height of World War II, when he was still considered an alien in Canada, he was contributing to the war effort as a scientific interpreter for the British, American and Canadian joint effort known as BSC located near Toronto and he was giving fishing and guiding tips to FDR's staff at his summer retreat on Manitoulin Island."

Other forgotten heroes and unexpected discoveries

I can't help but mention one more favorite figure in ice crawler research. The tale involves a quite modest Canadian postal worker, Matthew Geddes Campbell (1892-1940). It's also a nice opportunity to acknowledge the sizeable contributions of dedicated folks who simply love natural history (such as the 'Entomology Enthusiasts' championed by the Entomological Society of Canada).

Campbell was a Scottish émigré who, post-World War I, moved to Canada in 1921. He became the first door-to-door postal carrier in Kamloops, working and living there for several decades. As it happened, Campbell had a keen interest in entomology and became acquainted with J.D. Gregson, an entomologist at the Department of Agriculture lab in Kamloops. Gregson had found an unusual *Grylloblatta campodeiformis* population in the foothills of Mt. St. Paul in Kamloops in 1937 (unusual because of the semi-arid climate, as it sits at the northwestern edge of the Okanagan Region) and sparked Campbell's interest in this unusual insect.

Among the many notable efforts of Campbell to document ice crawler biology in Kamloops, my favorites are his efforts to rear and maintain colonies in his basement. I've managed to maintain individual ice crawlers for several years in my laboratory (in a 4°C walk-in refrigerator), but they inevitably die of something. I have yet to successfully get an egg to hatch, and the waiting time for a single molt can take up to a year (an estimate to the time from 1st instar to adulthood is about 6 years). Insect husbandry is not for the patient or light-hearted! Campbell, in his spare time, experimented with both temperature conditions and the design of enclosures to house ice crawlers. He described the surprising tolerance of ice crawlers for moderate ambient temperatures (below 15 °C), but their sensitivity to cold exposure (death can occur at -5 to -7 °C). The correspondence of M.G. Campbell and G.J. Spencer, published in the *Proceedings of the Entomological Society of British Columbia* (Campbell and Spencer 1949), documents these efforts. Among one of his more colorful remarks, Campbell aptly noted, "... it does NOT need to be cold enough to freeze the appendages of a brazen simian, in order to suit *Grylloblatta*. Altogether too much has been made of this temperature angle, ever since he was badly misnamed 'Ice Bug', A 'Rock Louse' would be a much more appropriate term."

If only we could inspire more of the public to contribute to our knowledge of obscure insect groups. Spencer quoted Campbell as having written, "I do not see how I, an untrained man, can add much to the work that has been done by Drs. Walker and Mills and Pepper. However, if anything I can do will benefit science in the smallest degree, you are more than welcome to it." I wish I could thank him for his inquisitive nature and his efforts.

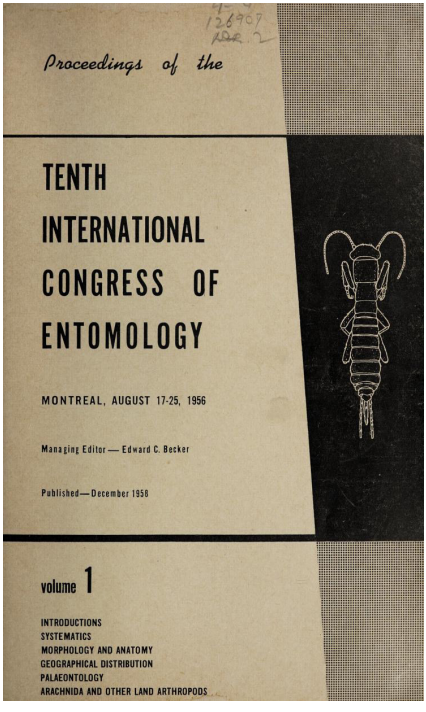
A special place in Canadian Entomology: The ESC logo

Ice crawlers hold a special place, of course, for the membership of the Entomological Society of Canada as the featured insect on the Society logo.

In preparing this blog, I asked Felix Sperling about the origin of the logo, who then forwarded my inquiry to Cedric Gillott. Cedric then pored through early issues of *The Canadian Entomologist*, contacted

The Entomological Society of Canada official logo.

Neil Holliday, and the two of them pursued various leads and contacts (thanks!). Although the logo clearly appears on the cover of the first Bulletin of the Entomological Society of Canada (1969), and was presented to ESC as a plaque at the joint annual meeting in 1967 by Société d'entomologie du Québec, records of when it originated and how it was adopted as an official logo remain a mystery. Perhaps the logo was inspired by the choice of *Grylloblatta campodeiformis* as an emblem for the official cover page of the 10th International Congress of Entomology meeting in Montreal in 1956 (C. Gillott, pers. comm.). If you happen to know, get in touch!



Cover of the Proceedings for the 10th International Congress of Entomology in Montreal, 1956.

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On 14 July 2019, Dr Jordan Lewis Burke lost his battle with cancer. With his passing, the forest entomology community lost a rising star.

Jordan L. Burke (1982 – 2019)

Jordan was born in Washington, D.C., on 8 November 1982, and lived in Alexandria, Virginia, where he attended T.C. Williams High School. He received his Bachelor of Science in Entomology (2009) and Master of Science in Forestry (2011) degrees from the University of Georgia. For his Master's research, Jordan worked in the Gandhi Forest Entomology Lab where he studied the effects of prescribed fire and subcortical beetles on southern pines in Georgia. This research instilled in him a passion for bark beetles which he brought with him to the Forest Insect Disturbance Ecology Lab (FIDEL), within the University of British Columbia's Faculty of Forestry, where he completed a PhD in Forest Entomology in 2016.

Jordan's love of forest entomology was matched by his aptitude for research, ability to solve complex problems and unwillingness to back down from a challenge. His doctoral project comprised a mix of detailed lab work and demanding field research in remote areas. He focussed on the consequences of climate-induced range expansion by the mountain pine beetle in western North America, and his research advanced our knowledge of bark beetle ecology and dynamics in several fundamental ways. He showed that due to differential rates of post-glacial recolonization of western North America by the mountain pine beetle and lodgepole pine, southern populations of lodgepole with long-term interactions with the beetle express specific defenses against beetle attacks that are largely absent from evolutionarily naïve host populations growing further north. He also found that the basis for the eruptive dynamic characteristic of mountain pine beetle outbreaks arises from context-dependent maternal effects where offspring of females from sub-outbreak populations avoid vigorous host trees, but the offspring from epidemic females prefer those trees given their capacity to overwhelm them via mass attacks. Following completion of his PhD, Jordan remained as a post-doctoral fellow in FIDEL where he continued his work with the mountain pine beetle, studying its capacity to persist in newly invaded pine forests.

In addition to his excitement for research, Jordan's enthusiasm extended to teaching. He began as a teaching assistant and then took on several roles as a sessional instructor within UBC's Faculty of Forestry where he taught both classroom and field-based courses. His passion for science in general, and entomology specifically, was absolutely infectious and his students loved him. He had an amazing ability to make any aspect of forest entomology sound fascinating, and FIDEL was soon bursting with undergraduate volunteers. His commitment to his students went well beyond teaching. Whether he was solving "existential crises" for students by searching out lost cell phones in the woods, providing additional instruction after class or labs, or supervising the research of undergraduate honours students, Jordan's dedication to mentorship was unparalleled.

Jordan's commitment to research and mentorship, coupled with his positive, outgoing personality made him a natural leader in the lab. His willingness to help in any aspect of a study,

no matter how tedious or repetitive, made him integral to virtually all FIDEL projects. His participation also provided him with fresh insights into ongoing research that he would then use in constructive discussions and debates with fellow students and research staff concerning study design, methods, data analyses and interpretation. Jordan's love of discourse continued outside the lab, and he was often found deep in discussions regarding intricacies of the latest forest entomology research project with diverse colleagues, faculty members and even administrative staff throughout the Faculty of Forestry.

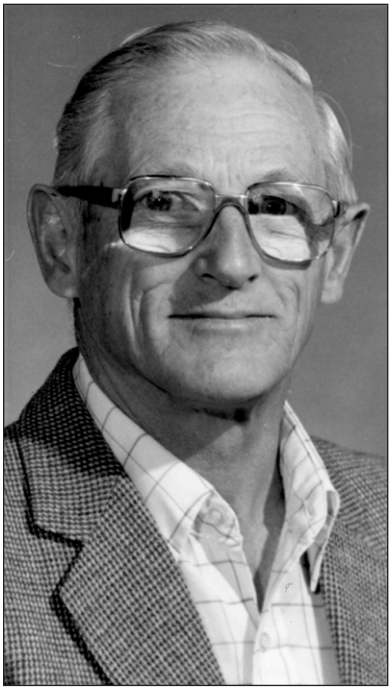
Jordan's interests in forest entomology also extended beyond academia. He was a member of the Entomological Societies of America, Canada and British Columbia. He was also deeply involved in the annual Western Forest Insect Work Conference where he served on the Technology Committee as webmaster for several years.

Jordan was exuberant about everything he did. He loved sharing his latest ideas with everyone, and was fearless in thinking outside the box. He was always willing to volunteer his time, and had a seemingly endless source of positive energy that affected everyone around him. Few people were more fun to be with at meetings, and he was always the focal point of extracurricular activities. He is missed tremendously by all those he touched.

Jordan is survived by his wife, Caleigh Minshall, his mother April L. Burke, his father Garrett C. Burke, his sister Liz Burke, his step-father Richard Flynt, and his step-mother Laura Budniakiewicz. Please visit https://memorial.support.ubc.ca/jordan-burke/ for a description of the UBC Faculty of Forestry scholarship that has been established in Jordan's honor to financially assist future graduate students at UBC who excel in teaching and inspiring students.

Allan Carroll, Forestry, University of British Columbia

James Francis (Frank) McAlpine (25 September 1922 – 3 December 2019)



Frank McAlpine, Ottawa 1984.

Frank grew up in Maynooth, Ontario, a village not far from Bancroft, the eldest of five boys in a farmhouse with no electricity. After primary education in a one-room schoolhouse, he went to Kemptville Agricultural College in 1938, at age 16, graduating in 1940. From 1942 to 1946 he was an elementary school teacher in the Ontario Public School System. In 1950 he obtained a BSA degree from the Ontario Agricultural College (now part of the University of Guelph), where he specialized in entomology. Frank and his wife Naomi moved to Ottawa from Maynooth in 1950 so he could begin working at the Systematic Entomology Division, Canadian National Collection of Insects (CNC), Agriculture Canada.

From the start, he immersed himself in his chosen field of study, Acalyptratae – tiny drosophilid-like flies. His first paper on the group appeared the next year (McAlpine 1951). Although we suspect this choice of the acalypterates may have been suggested by his two new dipterist colleagues, Guy Shewell and Richard Vockeroth, Frank was soon publishing extensively on both Lonchaeidae and Chamaemyiidae, from areas as far afield as Chile, on his way to becoming a world specialist on these and related families.

Frank initially joined the Diptera Unit of the CNC as part of a recruitment program associated with the Northern Insect Survey. He was a member of four of the annual summer survey parties, in Gillam, Manitoba (1950), Hebron, Labrador (1954), Isachsen, Nunavut (1960) and Hazen Camp, Nunavut (1962) (Riegert 1999).

Frank's initial field assignment was to Gillam in northern Manitoba, the second last stop on the railway south of Churchill. The railway was the only connection to the outside world, meaning that habitats would have to be located on foot, a tough assignment for a neophyte collector on his own. The blackflies required specialised equipment and were not well known then, and even the mosquitoes were disappointing. Enter the horseflies in July and August! To his credit, he learned to identify this material, first to appear as a list of species and later as a revision of the *Hybomitra frontaliis* complex (McAlpine 1961).

As if to test his mettle, the CNC's second choice for Frank's summer expedition was Hebron, Labrador. Hebron, in spite of its beauty, is probably near the bottom of most entomologists' wish lists. In those days, it was customary to send summer students and new recruits into the field alone. Nevertheless, in spite of the fact that Hebron is in the remote mountainous spine of northern Labrador, where the only contact in those days was an occasional supply vessel, Frank made it there and back.

With all this Northern experience under his belt, Frank was ready for anything that came his way, and it did in 1960. If Hebron wasn't cold enough, Isachsen certainly was. Sometimes called the "biological north pole", Isachsen was a weather station on Ellef Ringness Island, one of the

small islands on the northwestern flank of the Canadian Arctic Archipego. Frank was about to find out how difficult it would be to find anything in a place where the temperature was in the single digits for almost the entire 'summer'. Again he rose to the challenge, compiling a surprising list of insects and mites (McAlpine 1962, 1964, 1965). His summaries provide us with important base lines against which to compare changes in the Arctic fauna that may be accompanying global warming.

Frank was destined to fulfill one last ordeal in the Arctic. In 1962, Frank arrived for a summer's field work at the Defence Research Board of Canada's research camp on the northwestern shore of Lake Hazen, near the northern end of Ellesmere Island. While Hazen was farther north than Isachsen it was more centrally located – on a much larger island and away from the coast. Summer days could even be pleasant. Unfortunately, no one told him about the piles of reindeer hides that were stored in all the tents, and he didn't know that his old allergy to cow hides would kick in, in the presence of these reindeer hides. Frank managed to cope, however, by living apart from all the hides, but a good night's sleep was a luxury. To add insult to injury, or perhaps to get back at those who had brought so much destruction on its fellow ungulates, a bull muskox chased Frank up a hill – his most vivid memory of the experience was just how close those two sharp points were to his backside! Eventually, Frank's asthma prevailed, and he was flown out of Ellesmere Island, but not before he had added significantly to our understanding of the fauna of the High Arctic.

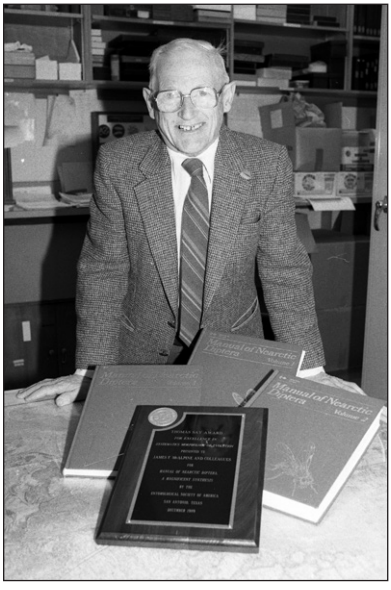
While employed at the CNC, Frank took educational leave to complete graduate work at the University of Illinois, Urbana, under the supervision of Herbert H. Ross, receiving an MSc in 1954, and a PhD in 1962 on the evolution and phylogeny of the Lonchaeidae of the world. A great advantage of working with Dr Ross was the opportunity for Frank to become familiar with Willi Hennig's Phylogenetic Systematics, and he made full use of this methodology. Although largely eclipsed by molecular systematics today, Hennig's method is still useful in understanding relationships between taxa, especially if genetic tools are not available or are inconclusive. In Urbana, Frank also found time to depart from the Diptera to take part in an analysis of postglacial distributional changes in winter stoneflies (Ross et al. 1967) and to initiate a study of the caddisflies of the genus Leptonema, which was eventually published years later (Flint et al. 1987).

Midway through his career, Frank discovered how to collect Canadian Cretaceous amber (McAlpine and Martin, 1969). Insect fragments had long been known from amber deposits, and many interesting fossils had been described, but Canadian amber was amongst the oldest and richest, formerly known from nodules collected in Western Canada, and from the shores of the Saskatchewan River in Manitoba. This river enters Lake Winnipeg via Cedar Lake, and the river's current is evidently just strong enough to carry amber nodules all the way to Cedar Lake where at that time they could be harvested from the shoreline debris. Frank made at least two expeditions to Cedar Lake, as well as one to Grassy Lake, near Medicine Hat, Alberta, returning with bushels of nodules. After much pollishing the nodules were examined for inclusions. This work resulted in several papers on fossil Diptera by Frank, one of which described a new genus and species from the family Ironomyiidae, previously known only from Australia.

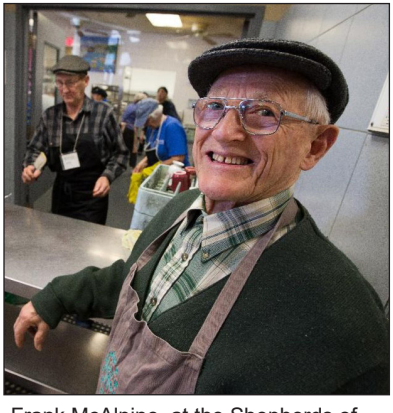
Frank published a total of 90 scientific papers during his prolific career, primarily on families of acalyptrate Diptera (see list in Cumming et al. 2011, Appendix A). Included were his significant contributions, 18 chapters in total, in the Manual of Nearctic Diptera. This three volume series (McAlpine et al. 1981, 1987; McAlpine and Wood 1989; available online at https://esc-sec.ca/publications/aafc/) remains as one of the most outstanding systematic treatments of any order of insects. As scientific editor of the Manual and one of six CNC Coordinators, Frank was essentially the leader of this 24-year multi-authored project. He wrote two of the important introductory chapters, one comprising a family key to adults and the other reviewing adult morphology and

terminology. Until very recently, Frank's morphology chapter was the standard adopted by virtually all dipterists worldwide, which provided a uniform homology-based terminology for Diptera that was clearly laid out and consistent with the rest of the insect orders. In the last volume, Frank finished his contributions to the Manual with publication of his phylogenetic synthesis of Cyclorrhapha (as Muscomorpha), in which he provided a cladistic classification of this huge lineage of flies. In 1989 the Manual was awarded the first Thomas Say Award for excellence in systematics, morphology and evolution by the Entomological Society of America (ESA). Frank accepted this prestigious award at the 1989 Annual ESA Meeting in San Antonio, Texas, on behalf of the other Coordinators and all 53 included chapter authors, referring to it as the highlight of his entomological career.

Frank participated in numerous insect collecting expeditions to the United States, Mexico, Australia and New Caledonia, as well as those within Canada. In total he published 251 new Diptera taxa (7 family group names, 9 genus group names, 235 species group names) and was honoured with 26 scientific patronyms attributed to him by other taxonomists in recognition of his scientific achievements (see http://www.canacoll.org/Diptera/Staff/McAlpine/McAlpine_Patronyms.pdf). He was also a regular visiting lecturer at the Lyman Entomological Museum of McGill University. For many years, Frank served as a Director of the Entomological Societies of Canada and Ontario, and as a Director of the Society of Systematic Zoology. Frank retired, after 35 years' service, in July 1985, but continued his research studies for several years at the CNC as an Honourary Research Associate until publication of the final volume of the Manual in 1989. Throughout his retirement, he kept busy with his large family, making maple syrup at his cottage each spring and volunteering once a week at the Shepherds of Good Hope kitchen in downtown Ottawa. He is survived by five of his children, eight grandchildren, six great-grandchildren, one brother and three nieces.



Frank McAlpine with the Thomas Say Award and Volumes 1–3 of the Manual of Nearctic Diptera, Ottawa 1990.



Frank McAlpine, at the Shepherds of Good Hope kitchen, Ottawa, in 2014 at the age of 92.

Jeffrey M. Cumming and D. Monty Wood
Canadian National Collection of Insects, Arachnids and Nematodes, Agriculture and Agri-Food Canada, Ottawa

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Books available for review / Livres disponibles pour critique

The ESC frequently receives unsolicited books for review. A list of these books is available online (http://esc-sec.ca/publications/bulletin/#toggle-id-2) and is updated as new books are received.

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You should briefly indicate your qualifications to review the topic of the book, and be able to complete your review within 8 weeks.

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Formatting of the review should follow that of reviews in recent issues of the Bulletin. A scan of the book cover (jpeg or tiff format, about 500 kb) should be submitted with the review.

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Les critiques de livre doivent compter entre 800 et 1200 mots. Elles doivent clairement identifier le sujet du livre et si le livre rencontre bien les objectifs énoncés. Les forces et faiblesses du livre devraient être décrites.

Le format des textes doit suivre celui des critiques des récents numéros du Bulletin. Une version numérisée de la couverture du livre (en format jpeg ou tiff, environ 500 kb) devra être soumise avec la critique.

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Danks, H.V. 2017. The Biological Survey of Canada: A Personal History. Biological Survey of Canada. ISBN: 978-0-9689321-9-3 [e-book].

Eiseman, C. 2019. Leafminers of North America. [e-book].

Forman, R.T.T. 2019. Towns, Ecology and the Land. Cambridge University Press. ISBN 978-1-316-64860-5 [paperback].

Frank, B., J.A. Klikman and S. Marchini. 2019. Human-Wildlife Interactions. Turning Conflict into Coexistence. Cambridge University Press. ISBN: 978-1-108-40258-3 [paperback].

Gibson, D.J. and J.A. Newman [Eds.]. 2019. Grasslands and Climate Change. Ecological Reviews. Cambridge University Press. ISBN 978-1-316-64677-9 [paperback].

Haine, J. 2020. Nature Underfoot. Living with Beetles, Crabgrass, Fruitflies and Other Tiny Life around Us. Yale University Press. ISBN 978-0-300-24278-2 [hardcover].

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Leidner, A.K. and G.M. Buchanan [Eds]. 2018. Satellite Remote Sensing for Conservation Action: Case Studies from Aquatic and Terrestrial Ecosystems. Cambridge University Press. ISBN 978-1-10845670-8 [paperback].

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Saguez, J. 2017. Guide d'identification des vers fil-de-fer dans les grandes cultures au Québec. Centre de recherche sur les grains. ISBN: 978-2-9813604-5-8 [e-book].

Skevington, J., M.M. Locke, A.D. Young, K. Moran, W.J. Crins and S.A. Marshall. Field Guide to the Flower Flies of Northeastern North America. 2019. Princeton University Press. ISBN 978-0-691-18940-6 [paperback].

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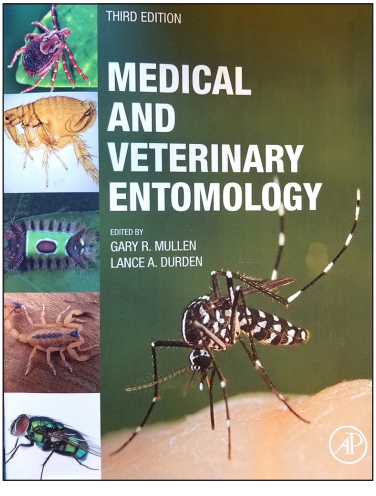
Wilson, K., Fenton, A., Tompkins, D., eds. 2019. Wildlife Disease Ecology. Linking Theory to Data and Application. Cambridge University Press. 978-1316-50190-0 [paper back].

Book reviews / Critiques de livre

***Medical and Veterinary Entomology, third edition*.** Mullen, G.R., Durden L.A. (Eds.). 2019. Academic Press, London, United Kingdom. 769 pp. ISBN 978-0-12-814043-7. CAD $117.76 (paperback), $131.14 (Kindle) (prices from Amazon.ca, retrieved 2 Feb 2020).



In a country historically protected by cold winters, Canadians haven't worried much about arthropod-borne diseases. This is changing with the spread of Lyme disease in southern Canada and with increased travel to places where a naïve Canadian may come in contact with unfamiliar arthropods. Even a short holiday in Los Angeles might result in a case of flea-borne typhus (County of Los Angeles 2019). As is eloquently argued by Mullens et al. (2018), it is important to be proactive in teaching undergraduates about insects and arachnids of medical and veterinary importance (especially as some of them might end up as medical doctors!). Felix Sperling and I are teaching the undergraduate course *Medical and Veterinary Entomology* (ENT 392) for the first time this semester. Each of us has dabbled in some med-vet related research (ticks for Felix, vertebrate-associated mites for me) but neither of us is an expert in the topic. We were on the lookout for a good textbook to guide us in creating our lectures. I'm happy to report that *Medical and Veterinary Entomology, third edition*, edited by Gary Mullen and Lance Durden, proved to be just what two neophyte Med-Vet Ent teachers needed.

The first two editions of the classic text *Medical and Veterinary Entomology* edited by Mullen and Durden were published in 2002 and 2009. In the 10 years since the second edition, a great deal of relevant research has been done, vector arthropods have expanded their ranges, and novel pathogens have appeared. Thus, it isn't surprising that the third edition is more than 100 pages longer than the second and includes 22 new or updated distribution maps. The book is divided into 28 chapters written by 40 contributors. All authors are based in the United States with two exceptions, one from Mexico and one from Canada (Douglas Colwell, AAFC Lethbridge). Most chapters are focused on particular arthropod taxa of medical and/or veterinary importance: one chapter for each of Blattaria, Phthiraptera, Hemiptera, Coleoptera, Siphonaptera, Lepidoptera, Hymenoptera, Scorpiones, Solpugida and Araneae; two for Acari (including ticks); and 10 chapters for the Diptera. The remaining six chapters deal with broader themes including a historical overview of the field, morphological adaptations of parasitic arthropods, toxins and venoms (a new chapter by Justin Schmidt), forensic entomology, and molecular tools relevant to medical and veterinary entomology. The book also includes a 10-page appendix of arthropod-associated viruses, a huge glossary with ~1700 terms, and both a taxonomic and a subject index. All of this comes in at 2.1 kg; very hefty for a paperback! So far, the sturdy binding and cover have held up to use.

A text with 40 authors could end up a disjointed collection of chapters with clashing styles, but this is not the case with *Medical and Veterinary Entomology, third edition*. Most of the taxon-based chapters follow a similar layout with the following categories: taxonomy, morphology, life history, behaviour and ecology, taxa of med-vet interest, public health importance, veterinary importance, and prevention and control. This consistency together with the detailed table of contents makes it easy to find desired sections and to construct coherent lectures. If one has access to the electronic version of the text it is even easier to find things simply by searching with key words. I also exploited my library's subscription to the electronic version by taking screen grabs of many of the >500 excellent diagrams and photos to illustrate my PowerPoint lectures. As a warning, there are numerous disturbing images of animals (including humans) suffering from ailments induced by arthropods. If you have a weak stomach, try to avoid looking at photos in the myiasis chapter! The distribution maps principally show the distribution of diseases rather than arthropods with the exceptions of maps for tsetse flies, the fire ant *Solenopsis invicta* and *Latrodectus* spp. (widow spiders). I was a little disappointed that the maps for tick-associated diseases in North America show only the lower U.S. states, implying to casual readers that Canada is free of Lyme, relapsing fever and spotted fever.

The importance of medical and veterinary entomology is resurging around the world. Changing climate, emerging diseases, evolution of resistance by arthropods and the microbes they vector, and increased travel by humans (and their pets) are creating a dynamic and unpredictable landscape of risk. *Medical and Veterinary Entomology, third edition* is an excellent overview of this complex multidisciplinary field. I strongly recommend it for students, lecturers, veterinarians, medical doctors and public health officials.

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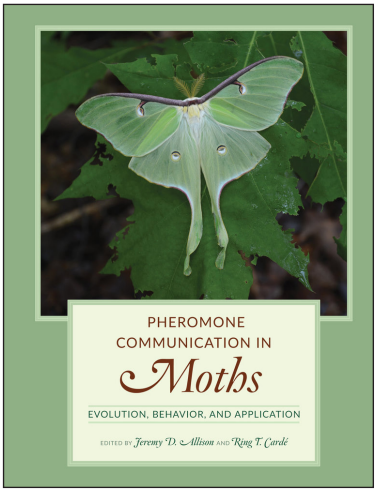
Pheromone Communication in Moths - Evolution, Behavior, and Application. Allison, Jeremy D. and Cardé, Ring T., editors. 2016. University of California Press, Oakland, California. 401 pp. ISBN: 9780520278561. Hardcover. CAN$ 89.85.



This large volume provides an insight into the spectrum of research into moth pheromones and the important role they play, notably the sex pheromones produced by females for long-distance attraction. Did you know that the pheromone composition of only 2000 species (out of ca. 160 000 Lepidoptera, the second largest insect order) is known?

Edited by Jeremy D. Allison (research scientist with Natural Resources Canada at the Great Lakes Forestry Centre) and Ring T. Cardé (Distinguished Professor of Entomology at the University of California, Riverside), the book comprises 24 chapters, written by 36 contributors from a wide range of fields. Among the authors are five Canadian scientists (Eldon S. Eveleigh, Canadian Forest Service Fredericton; Maya Evenden, University of Alberta; Kirk Hillier, Acadia University; Peter Silk, Canadian Forest Service Fredericton; and Jeremy D. Allison).

The book is divided into three unequal parts, but the gradual sequence of ideas and complexity is relevant and well organized. The first part (12 chapters) constitutes a good introduction to pheromones and is really well written for people that are new to the discipline. The second part of the book (nine chapters) addresses different case studies. The third part (three chapters) includes chapters on the use of pheromones to monitor pests and to disrupt mating in integrated pest management programs.

The early chapters enable readers to become familiar with the concepts associated with pheromone communication and thus to understand the other parts of the book. For example, the first chapter presents the beginning of the discipline with the identification of the silkworm moth pheromone in 1959 and the different challenges to identify other pheromones and study them. The other chapters in the first part of the book adeal with mating, male preferences, and the exogenous and endogenous factors that may affect calling by females. In this first part of the book, readers are also introduced to the different types of pheromone, their structure, their phylogeny, their distribution and their evolution, notably in Chapter 4 which is highly detailed.

Chapter 5 is dedicated to sexual selection, including how pheromone blend composition released by females of different ages may affect male attraction and how males discriminate and select females with which to mate. This strategy does not fit with the more commonly observed scheme in nature in which males highlight their best assets to attract females. In moths, the production of pheromone may induce female-female competition in several species. In Chapter 6, the authors discuss the interesting idea of how plant volatiles could interact with pheromones. These interactions could be inhibitory, additive or synergistic, leading to attraction or repulsion of males, thereby serving as a base for the development of pest management programs.

Other chapters in the first part focus on the biological and physiological mechanisms involved in pheromone reception. Chapter 10 gives many details on neurophysiological aspects of the perception of pheromone. This chapter presents the olfactory and visual systems and the links between them. In the next chapter, the author describes the orientation of males along pheromone

plumes. This chapter shows how the plumes are generated, their fluxes and dispersal in the environment and how males encounter and fly upwind along the pheromone plume to the source. The last chapter of this first part is devoted to the underestimated and less described role of male pheromones in moths.

The second part of the book considers different case studies, focusing on the genera *Yponomeuta*, *Ostrinia*, *Utethesia*, *Ctenopseustis*, *Planotortrix*, *Spodoptera*, *Heliothis* and *Helicoverpa* from different parts of the world (e.g., Japan, New Zealand, and North America). In several chapters of this section of the book, authors highlight the importance of a good knowledge of the pheromone, notably the different isomers and blends of components that may differ depending on the species and the strains under consideration. They also present specific examples of models of pheromone evolution in moths and demonstrate the importance of experimental tests and methods (e.g., flight tunnel and assays for olfactory receptors) to determine the responses of males exposed to different blends. All these aspect must be considered in order to understand the distribution of moth species because some blends are specific to geographic regions.

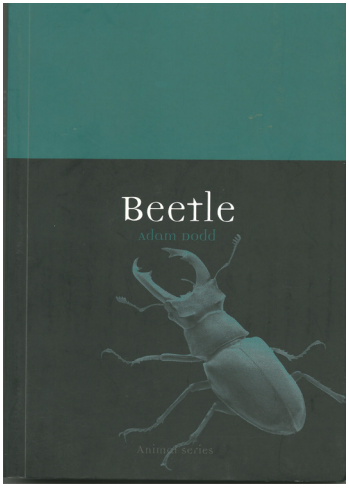
For a long time, pheromones have been identified and synthesized to develop detection and monitoring programs, notably producing synthetic pheromones for use as lures in bait traps. The third part of the book mainly focuses on the use of pheromones in integrated pest management (IPM). Regrettably, only three chapters deal with this aspect. Chapter 22 introduces the reader to trapping moths with pheromones, and the authors describe the different applications of trapping and their purposes, notably in IPM (e.g., evaluation of the species and their density) and biosecurity programs (e.g., detection of alien species). This chapter also mentions the problems that may be encountered when using pheromone traps. The second chapter of this section addresses the use of pheromones as management tools, notably to trap and kill pests. The authors present a review of different studies conducted on many economical pests including *Spodoptera littoralis*, *Plutella xylostella*, *Trichoplusia ni*, *Tuta absoluta*, *Cydia pomonella*, and *Grapholita molesta*. The last chapter focuses on the use of pheromones to disrupt mating. The author explains the various mechanisms that may be used to disrupt mating and discusses the interactions between these mechanisms (neurophysiological effects, sensory imbalance, camouflage and false trail following). This chapter also focuses on the importance of synthetic pheromone formulations, the kinds of dispenser and blends used, and other considerations taken to ensure a significant effect. This chapter also describes why adoption of mating disruption programs based on pheromones has increased during the last few decades.

The book is illustrated by numerous figures, including 28 in color. Some illustrate pheromone biosynthesis, while others show phylogenetic trees and mechanisms of pheromone release. The book also contains several images taken using macrophotography, and confocal and scanning electron microscopy.

In my opinion, this book clearly illustrates the interdisciplinary nature of the subject and is a useful resource for many entomologists. It could also be useful for chemical ecologists and pest-management researchers that have an interest in and wish to study or use pheromones.

Julien Saguez
CÉROM, Centre de recherche sur les grains, Saint-Mathieu-de-Beloeil, Québec.

Beetle. Dodd, A. 2016. Reaktion Books. London. 224 pp. ISBN 978-1-78023-48-5. Paperback. CAN$ 8.49.



Like most books in the Animal series, *Beetle* by Adam Dodd covers a lot of information about the animals that fall within this title. The book is divided into five major sections: Coming to Terms with Beetles, Sacred Beetle, Scientific Beetle, Managing Beetles, and Popular Beetle, followed by timelines, references, a select bibliography, list of beetle associations and websites, and acknowledgments.

The first section 'Coming to Terms with Beetles' focuses on the fascination and long history humans have with beetles. It is an introduction to beetle biology, natural history observations and an overview of beetles. 'Sacred Beetle' is a section focused on the mythological views of beetles and how they were worshipped in ancient civilisations. This section mentions stag, scarab, and dung beetles from ancient Egypt to the 17th century. The following section, 'Scientific Beetle', goes into the history of studying beetles from the 16th century on, but also touches on Pliny. 'Scientific Beetle' also delves into the collection, pinning, categorization and nomenclature of beetles. The fourth section 'Managing Beetles' is all about the impact of beetles on agricultural crops and in forestry, as well as invasive species. Some of the species mentioned in this section are the Colorado potato beetle, the boll weevil, longhorn beetles, and ladybird beetles. The final section 'Popular Beetle' focuses on the place of beetles in current human culture. This section includes the use of beetles and beetle parts (e.g., elytra) across the world. There are mentions of movies, jewellery, vehicles, and fine art.

The book ends with information on the 'Timeline' of beetles, covering the time from the first discovery of beetles in the fossil record through to the current views of these creatures and creation of video games.

This book is a nice overview of beetles and how human society views them, written in a way that is suitable for the general public. I really like the inclusion of details of associations and websites to encourage those interested into expanding their horizons. I recommend having this book on your shelf if you like general and random knowledge books or, of course, beetles.

Julia Mlynarek, Agriculture and Agri-food Canada, Harrow RDC

Véronique Martel Service Award recipient
Récipiendaire d'un prix de long service

The ESC Board is pleased to announce Dr Véronique (Véro) Martel as the newest recipient of an ESC Service Award in recognition of her cumulative contributions to the Society.

Véro has Chaired the Bilingualism Committee for over 14 years, during which time she has provided the majority of French translations for all of the ESC Board's official communications to the membership. These communications include the President's quarterly UpFront columns, translations of biographies and application information for nominees (2nd VP, Directors-at-Large) and awardees (Gold Medal, Hewitt, Criddle), ballots, meeting announcements, and French translations for the ESC website.

The award also recognizes Véro's contributions as a long-term Subject Editor for *The Canadian Entomologist*. As one of the few francophone members on the editorial board, she historically has been assigned many of the manuscripts submitted in French, which has increased her editorial workload.

Most recently, Véro organized the very successful President's Prize competition for JAM 2019 in Fredericton, and redesigned the scoring sheets to facilitate feedback from the judges to the students.

Throughout this period, Véro has been upbeat and prompt in responding to the Board's many requests for her time. The Board is extremely grateful for all of the work that she has done and continues to do for the Society.

Gail Anderson, President
Entomological Society of Canada

Le CA de la SEC est ravi d'annoncer Dre Véronique (Véro) Martel comme nouvelle récipiendaire d'un prix de long service de la SEC en reconnaissance de ses contributions cumulatives à la Société.

Véro préside le comité du bilinguisme depuis plus de 14 ans, durant lesquelles elle a fourni la majorité des traductions en français pour les communications officielles du CA de la SEC aux membres. Ces communications incluent la rubrique trimestrielle de l'Avant-Propos du président, les traductions de biographies et les informations de candidatures (second V.-P., conseillers) et des récipiendaires de prix (médaille d'or, Hewitt, Criddle), les élections, les annonces de réunions et les traductions pour le site web.

Le prix reconnaît également les contributions de Véro comme éditrice thématique de longue date pour *The Canadian Entomologist*. Comme une des rares francophones sur le comité éditorial, elle s'est historiquement fait assigner bon nombre de manuscrits soumis en français, ce qui a augmenté sa charge de travail éditorial.

Plus récemment, Véro a organisé la compétition du prix du président pour la réunion annuelle conjointe 2019 à Fredericton, et a modifié la feuille d'évaluation pour faciliter les commentaires des juges aux étudiants.

Durant cette période, Véro a été enjouée et prompte à répondre aux nombreuses requêtes du CA. Le CA est extrêmement reconnaissant pour tout le travail qu'elle a fait et continue de faire pour la Société.

Gail Anderson, Présidente
Société d'entomologie du Canada

70th Annual Meeting of Members and Board of Directors Meetings (JAM 2020)

The Annual Business Meeting of Members of the Entomological Society of Canada will be held at the Carriage House Inn, 9030 Macleod Trail South, Calgary, Alberta, on Tuesday, 20 October 2020. The outgoing Board of Directors Meeting will be held on Sunday, 18 October 2020, from 8:00 am to 1:00 pm in the Carriage House Inn. The incoming Board of Directors will meet immediately following the Annual Business Meeting of Members, and in the same venue as that meeting. Matters for consideration at any of the above meetings should be sent to Neil Holliday, Secretary of the Entomological Society of Canada (see inside back cover for contact details).

70e assemblée annuelle des membres et réunions du conseil d'administration (RAC 2020)

L'assemblée annuelle des membres de la Société d'entomologie du Canada se tiendra à l'hôtel Carriage House Inn, 9030 Macleod Trail South, Calgary, Alberta, le mardi 20 octobre 2020. La réunion du conseil d'administration sortant se tiendra le dimanche 18 octobre 2020, de 8h à 13h à l'hôtel Carriage House Inn. Le nouveau conseil d'administration se réunira immédiatement après l'assemblée annuelle des membres, au même endroit que l'assemblée. Tout sujet à considérer pour l'une des réunions mentionnées ci-dessus doit être envoyé à Neil Holliday, secrétaire de la Société d'entomologie du Canada (voir la troisième de couverture pour les informations de contact).

Executive Meeting - Call for Agenda Items

If members have any items they wish to be discussed at the next Board of Directors or Executive Council meeting, please send them to the Secretary, Neil Holliday (see inside back cover for contact details), as soon as possible.

Réunion du conseil exécutif – Points à l'ordre du jour

Si des membres aimeraient ajouter des points à l'ordre du jour pour discussion à la prochaine réunion du Bureau des directeurs ou du Conseil de l'exécutif, merci de les envoyer au secrétaire, Neil Holliday (voir le troisième de couverture pour les informations de contact), le plus tôt

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Members' discounts

Entomological Society of Canada members can enjoy discounts on publications from Annual Reviews, Elsevier, Cambridge University Press, and the Entomological Society of America. Details of how to benefit from these discounts are available on the member's area of the Entomological Society of Canada website at: https://esc-sec.site-ym.com/.

Remise pour les membres

Les membres de la Société d'entomologie du Canada peuvent bénéficier d'une remise lors d'achats de publications de : Annual Reviews, Elsevier, Cambridge University Press et de la Société d'entomologie d'Amérique. Les informations nécessaires pour profiter de ces remises sont disponibles dans la section des membres du site de la Société d'entomologie du Canada à : https://esc-sec.site-ym.com/.

Highlights of the recent Board of Directors meeting

The ESC Board of Directors met by teleconference on Monday, 25 November 2019. A primary purpose of this meeting was to orient new members of the Board to the governance structures and practices of ESC and to acquaint new directors with the responsibilities of directorship. Executive Director, Geoff Powell, led the orientation segment of the meeting.

The Board learned that the Executive Council had set completion of the revision of the Guidelines for Organizing a Joint Annual Meeting (JAM) as a priority for the 2019–20 society year. New initiatives for the year are to evaluate whether the committee structures that were approved in January 2019 are working effectively, and to develop a strategy for making ESC committees more effective with more equitable work load among committee members. Executive Council had also discussed the ESC's strategic planning cycle, given that the last formal strategic planning exercise was in October 2017. It was agreed that a full review of ESC's financial status and sustainability would be carried out in the 2020–21 society year, and a strategic planning exercise would be held in conjunction with the 2021 JAM.

Another priority that Executive Council had identified for 2019–20 was the establishment of organizational protocols for NAtional Insect Appreciation Day (NAIAD) so that information about future NAIADs would reach more members of the public but require less ongoing effort. Étienne Normandin, Chair of the Public Education Committee, reported on progress towards this objective. The Committee has developed two posters and developed a timeline for activities leading to NAIAD. A press release is under development, but a press release requires a media distribution list. A media list could also be used for press releases about Achievement Awards and JAMs. The Board requested that information be obtained on the costs and characteristics of commercially-available regional and national media contact lists.

The Board received information on past and future JAMs. The 2019 JAM with the Canadian Society for Evolution and Ecology (CSEE) and the Acadian Entomological Society generated a surplus, but final accounting has yet to be completed. In the ESC's survey regarding the 2019 JAM, there was a high degree of satisfaction with the registration and paper submission services provided by ESC's association management company, and most respondents were satisfied with the scientific content of the meeting. However, many expressed the view that entomological components of the program were "tacked on" to the CSEE framework, and that this was detrimental to ESC attendees. Reports were received on future JAMs 2020–2023. A detailed report was received on preparations for the 2020 JAM and it was noted that the fund-raising campaign for this meeting was well advanced. Of particular note is the finalizing of dates and venue for the 2021 JAM, which will be at the Marriot on the Falls Hotel, Niagara Falls, Ontario, on 3-6 October 2021.

The Board received the information that the draft ESC Meeting Code of Conduct had been referred for legal opinion to ensure that it is legally sound, and so that any issues of liability for ESC or its officers are clearly understood. The Board was also informed that Executive Council had drafted a policy on surplus-sharing when JAMs involving a third society, such as the Entomological Society of America, generate large surpluses. The draft policy had been sent to regional societies for comment and, once this process was complete, would be presented to the Board for consideration. The Board received a recommendation from the Annual Meeting Committee that ESC be the host and creator of JAM websites; this recommendation was referred to the ESC's webmaster for consideration. The Board also received a progress report on the revision of the Guidelines for Organizing a Joint Annual Meeting, on which Chris MacQuarrie and Suzanne Blatt have been working, with a view to making the document current and easier to use.

The revision will soon be ready for examination by others on the review committee.

Past-president, Kevin Floate, presented a policy providing guidelines on how the ESC should respond to requests for donations. The policy outlines what information is required to support a request and what criteria should be used in evaluation. Small requests could be approved by Executive Council, but larger requests would require a vote of the Board. As part of the ESC budget approval process, a cap will be established for total donations for the fiscal year. The Board approved the policy.

The Board received information on the series "Canada's Coolest/Cruelest Insects", which had been initiated as a blog post in May 2018, but for which there had not been further posts. Recently, two contributions had been received, and these are to be published in the *ESC Bulletin* as well as on the blog. At least one more contribution is expected soon. There was discussion of ways to encourage more submissions. Those interested in making a submission can obtain a template and examples from the ESC's social media administrators.

ESC had earlier committed to the International Congress of Entomology (ICE) to provide $2500 in travel awards to student members travelling to the 2020 meeting in Helsinki, Finland. The Board received an update on the competition for ICE student travel awards, for which the closing date for applications had passed just before the Board meeting. Three awards, each of $850, were available, and a total of 14 applications had been received. Successful applicants would be notified before the deadline for early bird registration, and payments would be made after evidence of attendance was provided. It was agreed that, in view of the long period between applications and the meeting, close runners-up would be notified that they might receive an award if an initial awardee did not attend ICE.

The Board approved minor changes to the Committee Guidelines. These will reduce the workloads of the chair of the Student Awards Committee and of the coordinator of the President's prize competitions. Another change removed the implication that only students supervised by university faculty members are eligible for Ed Becker Conference Travel Awards. The Board also approved a proposal from the Publications Committee to establish "special issue symposia" at JAMs. Symposium organizers at a JAM could apply to the Publications Committee to have their symposium designated as a special issue symposium. Papers in such designated symposia would, subject to normal peer-review processes, be published together as a special issue of *The Canadian Entomologist*. Special issues of the journal are part of the regular page budget of the journal but are distinguished because the papers are on related topics.

Seeking next ESC Treasurer / À la recherche du prochain trésorier de la SEC

The Entomological Society of Canada is looking to fill the position of Treasurer, beginning in autumn 2020. Please note that the Treasurer is considered an officer of the Society and is expected to attend the annual meeting of the Governing Board. The Treasurer's cost of attending this meeting is covered by ESC in the event the Treasurer does not have funding from another source for such expenses.

The duties include, but are not limited to, custody of the Society's funds, reporting on the finances of the Society when required, submitting a budget to the June Board meeting, submitting an audited financial statement at the end of each financial year to the membership by posting it in the members' area of the Society's website, overseeing the day-to-day business operations of the ESC, and serving as an ex officio member of several committees. Previous experience with financial reporting and/or accounting would be an advantage, as is a general knowledge of the affairs of the Society. Please express your interest in the position to the President, Gail Anderson, by 15 May 2020 (ESCPresident@esc-sec.ca). The final selection will be made by an ad hoc committee convened by the President.

La Société d'entomologie du Canada cherche à combler le poste de trésorier, à compter de l'automne 2020. Veuillez noter que le trésorier est considéré comme un dirigeant de la Société et doit assister à la réunion annuelle du conseil d'administration. Les coûts d'assister à la réunion pour le trésorier est couvert par la SEC dans le cas où le trésorier n'a pas de fonds d'une autre source pour ces dépenses.

Les tâches incluent, mais ne se limitent pas à la garde des fonds de la Société, produire des rapports sur les finances de la Société lorsque requis, soumettre un budget à la réunion du CA de juin, soumettre un état financier vérifié aux membres à la fin de chaque année financière en l'affichant dans la section des membres de la Société sur le site web, superviser les opérations d'affaires de la SEC au jour le jour, et servir comme membre ex officio de plusieurs comités. Une expérience passée dans la production de rap-ports financiers et/ou en comptabilité serait un avantage, ainsi qu'une connaissance générale des affaires de la Société. Merci de manifester votre intérêt pour ce poste auprès du Président, Gail Anderson, d'ici le 15 mai 2020 (ESCPresident@esc-sec.ca). La sélection finale sera faite par un comité ad hoc convoqué par le Président.

Sixteenth Annual Photo Contest

The 16th Annual Photo Contest to select images for the 2021 covers of *The Canadian Entomologist* and the *Bulletin of the Entomological Society of Canada* is underway. The cover images are intended to represent the breadth of entomology covered by the Society's publications. Insects and non-insects in forestry, urban or agriculture; landscapes, field, laboratory or close-ups; or activities associated with physiology, behaviour, taxonomy or IPM are all desirable. A couple of 'Featured Insects' are also needed. If selected, your photo will grace the cover of both publications for the entire year. In addition, winning photos and a selection of all submitted photos will be shown on the ESC website.

Contest rules:

Photos of insects and other arthropods in all stages, activities, and habitats are accepted. To represent the scope of entomological research, we also encourage photos of field plots, laboratory experiments, insect impacts, research activities, sampling equipment, etc. Photos should, however, have a clear entomological focus.

Digital images must be submitted in unbordered, high-quality JPG format, with the long side (width or height) a minimum of 1500 pixels.

Entrants may submit up to five photographs. A caption must be provided with each photo submitted; photos without captions will not be accepted. Captions should include the locality, subject identification as closely as is known, description of activity if the main subject is other than an insect, and any interesting or relevant information. Captions should be a maximum of 40 words.

The entrant must be a member in good standing of the Entomological Society of Canada. Photos must be taken by the entrant, and the entrant must own the copyright.

The copyright of the photo remains with the entrant, but royalty-free use must be granted to the ESC for inclusion on the cover of one volume (6 issues) of *The Canadian Entomologist*, one volume (4 issues) of the *Bulletin*, and on the ESC website.

The judging committee will be chosen by the Chair of the Publications Committee of the ESC.

The Photo Contest winners will be announced on the ESC website, and may be announced at the Annual Meeting of the ESC or in the *Bulletin*. There is no cash award for the winners, but photographers will be acknowledged in each issue in which the photos are printed.

Submission deadline is 31 August 2020. Entries should be submitted as an attachment to an email message; the subject line should start with "ESC Photo Contest Submission". Send the email message to: photocontest@esc-sec.ca.

Seizième concours annuel de photographie

Le seizième concours annuel de photographie visant à sélectionner des images pour les couvertures de *The Canadian Entomologist* et du *Bulletin de la Société d'entomologie du Canada* pour 2021 est en cours. Les images sur la couverture doivent représenter l'étendue entomologique couverte par les publications de la Société. Des photos représentant des insectes ou autres arthropodes forestiers, urbains ou agricoles, des paysages, du travail de terrain ou de laboratoire, des gros plans, ainsi que montrant des activités associées àla physiologie, au comportement, à la taxonomie ou à la lutte intégrée seraient souhaitées. Deux « insectes vedettes » sont également recherchés. Si elle est sélectionnée, votre photo ornera la couverture des deux publications pour l'année entière. De plus, vos photos gagnantes et une sélection de photos soumises seront montrées sur le site Internet de la SEC.

Règlements du concours :

Les photos d'insectes et autres arthropodes à n'importe quel stade, effectuant n'importe quelle activité et dans n'importe quel habitat sont acceptées. Afin de représenter les sujets de la recherche entomologique, nous encourageons également les photos de parcelles de terrain, expériences de laboratoire, impacts des insectes, activités de recherche, équipement d'échantillonnage, etc. Les photos doivent, cependant, avoir un intérêt entomologique clair.

Les images numériques doivent être soumises sans bordure, en format JPG de haute qualité, avec le plus grand côté (largeur ou hauteur) d'un minimum de 1500 pixels.

Chaque participant peut soumettre jusqu'à cinq photographies. Une légende doit être fournie pour chaque photo soumise : les photos sans légendes ne seront pas acceptées. La légende doit inclure la localisation, l'identification du sujet le plus précisément possible, la description de l'activité si le sujet n'est pas un insecte, et toute information intéressante ou pertinente. Les légendes doivent avoir une longueur maximale de 40 mots.

Les participants doivent être membres en bonne et due forme de la Société d'entomologie du Canada. Les photos doivent avoir été prises par le participant, et le participant doit en posséder les droits d'auteur.

Le participant conserve les droits d'auteur de la photo, mais l'utilisation libre de droits doit être accordée à la SEC afin de l'inclure sur la couverture d'un volume (6 numéros) de *The Canadian Entomologist*, un volume (4 numéros) du *Bulletin*, et sur le site Internet de la SEC.

Le comité d'évaluation sera choisi par le président du comité des publications de la SEC.

Les gagnants du concours de photographie seront annoncés sur le site Internet de la SEC et pourront être annoncés à la réunion annuelle de la SEC ou dans le *Bulletin*. Il n'y a pas de prix en argent pour les gagnants, mais les photographes seront remerciés dans chaque numéro où les photos seront imprimées.

La date limite de soumission est le 31 août 2020. Les soumissions doivent être faites en pièces jointes d'un courrier électronique. L'objet du message doit débuter par « Soumission pour le concours de photographie de la SEC ». Envoyez vos courriels à: photocontest@esc-sec.ca.

Announcements / Annonces

Entomo-l

Our listserv has been running for 29 years continuously. Entomo-l was launched in late 1990 for initial testing in Canada, following the meetings of the Entomological Society of Canada that year. For the first few months, membership was restricted to invited members of the ESC to assess the system. All went well, and in 1991, Entomo-l was open to the world. I suspect Entomo-l is one of the longest lasting listservs. It has spawned a number of other entomological communications networks.

Peter G. Kevan, List Owner

List of Contents: Regional Society Journals / Table des matières : Revues des sociétés régionales

This regular feature highlights research published in the five regional society journals that include peer-reviewed papers. It should be noted that some regional society journals are not published on a regular basis and may not always include peer-reviewed articles.

Cette rubrique régulière met en lumière la recherche publiée dans les cinq revues des sociétés régionales qui incluent des articles révisés par les pairs. Veuillez noter que certaines revues des sociétés régionales ne sont pas publiées sur une base régulière et peuvent ne pas toujours inclure des articles évalués par les pairs.

Journal of the Acadian Entomological Society, Volume 15 (published on various dates)
(JAES may be viewed at https://www.acadianes.ca/journal.php)

The efficacy of Formic Pro™ and 65% liquid formic acid against varroa mite (*Varroa destructor*) in honey bee (*Apis mellifera*) colonies in autumn in Nova Scotia, Canada. Cameron Menzies, Sawyer Olmstead, Robyn McCallum, and Chris Cutler. Pages 40-45, November 2019. Full Text

Apivar® and Bayvarol® suppress varroa mites in honey bee colonies in Canadian Maritime **Provinces.** Sawyer Olmstead, Cameron Menzies, Robyn McCallum, Kathleen Glasgow, and Chris Cutler. Pages 46-49, November 2019. Full Text

THE CANADIAN PHYTOPATHOLOGICAL SOCIETY

LA SOCIÉTÉ CANADIENNE DE PHYTOPATHOLOGIE

CPS-SCP News

VOL. 63, NO. 4 (Dec 2019)

https://phytopath.ca/wp-content/uploads/2020/01/CPS-SCP-News-63-4-Dec2019.pdf

http://biologicalsurvey.ca/newsletter/vol38(2).pdf

In this issue

Meeting announcements / Réunions futures

Entomological Society of America International Branch: Third Virtual Symposium
27–29 April 2020
https://www.entsoc.org/event-calendar/international-branch-2020-virtual-symposium

26th International Congress of Entomology (Entomology for our planet)
Helsinki, Finland, 19–24 July 2020
http://www.ice2020helsinki.fi/

Society for Invertebrate Pathology Annual Conference
Merida, Mexico, 2–6 August 2020
(no website to date)

Joint Annual Meeting of the Entomological Society of Canada and the Entomological Society of Alberta
Calgary, 18–21 October 2020
https://jam2020.ualberta.ca/

Entomological Society of America Annual Meeting
Orlando, Florida, 15–18 November 2020
https://www.entsoc.org/event-calendar/entomology-2020

10th International IPM Symposium: Implementing IPM across Borders and Disciplines
Denver, 15–18 March 2021
https://ipmsymposium.org/2021/index.html

Second International Congress of Biological Control (ICBC2)
Davos, Switzerland, 26–30th April 2021
https://www.iobc-icbc.com/index.php?cat=show_start

XVIth International Conference on Ephemeroptera and XXIth International Symposium on Plecoptera
Fort Collins, Colorado, 25 July–1 August 2021
(no website to date)

Society for Invertebrate Pathology Annual Conference
Port Elizabeth, South Africa, 1–5 August 2021
(no website to date)

Joint Annual Meeting of the Entomological Society of Canada and the Entomological Society of Ontario
Niagara Falls, 3–6 October 2021
(no website to date)

Readers are invited to send the Editor notices of entomological meetings of international, national or Canadian regional interest for inclusion in this list.

Les lecteurs sont invités à envoyer au rédacteur en chef des annonces de réunions entomologiques internationales, nationales ou régionales intéressantes afin de les inclure dans cette liste.

Bulletin of the Entomological Society of Canada

Editor: Cedric Gillott
Assistant Editor: Donna Giberson

The *Bulletin of the Entomological Society of Canada*, published since 1969, presents quarterly entomological news, opportunities and information, details of Society business, matters of wider scientific importance and book reviews.

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The Entomological Society of Canada was founded in 1863 primarily to study, advance and promote entomology. It supports entomology through publications, meetings, advocacy and other activities.

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Submission deadline for the next issue: 30 April 2020

Bulletin de la Société d'entomologie du Canada

Rédacteur: Cedric Gillott
Rédactrice adjointe: Donna Giberson

Le *Bulletin de la Société d'entomologie du Canada*, publié depuis 1969, présente trimestriellement des informations entomologiques, des occasions, des renseignements sur les opérations de la Société, des dossiers scientifiques d'importance et des analyses d'ouvrages.

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La Société d'entomologie du Canada a été établie en 1863 principalement pour promouvoir l'étude et l'avancement de l'entomologie. Elle soutient l'entomologie par l'entremise de publications, de réunions et d'autres activités.

Envoyer vos soumissions à:
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ISSN: 0071-0741

Date de tombée pour le prochain numéro: 30 avril 2020

Officers of affiliated Societies, 2019-2020
Dirigeants des Sociétés associées, 2019-2020

Entomological Society of British Columbia

President	Tammy McMullan
1st Vice President:	Wim Van Herk
2nd Vice President:	Chandra Moffat
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Treasurer	Ward Strong
Editor (Journal)	Kathy Bleiker
Editor (Boreus)	Gabriella Zilahi-Balogh
Webmaster	Brian Muselle
Secretary	Tracy Hueppelsheuser

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Entomological Society of Alberta

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Editor (Proceedings)	Bette Beswick
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Agriculture and Agri-Food Canada /
Agriculture et Agroalimentaire Canada
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E-mail: esalberta@gmail.com
http://www.entsocalberta.ca

Entomological Society of Saskatchewan

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Vice-President	Stephen Srayko
Past President	Daniel Wiens
Treasurer	Tyler Wist
Newsletter Editor	Nicole Pillipow
Secretary	Iain Phillips

Saskatchewan Watershed Authority
101-108 Research Drive, Saskatoon, SK, S7N 3R3
Tel: (306) 933-7474
Email: iain.phillips@swa.ca
http://www.entsocsask.ca

Entomological Society of Manitoba

President	Alejandro Costamagna
President-Elect	Jeffrey Marcus
Past President	Erica Smith
Treasurer	Kathy Cano
Newsletter Editors	Marjorie Smith & Kateryn Rochon
Editor (Proceedings)	Terry Galloway
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Secretary	Sarah Semmler

Living Prairie Museum
2795 Ness Ave
Winnipeg MB R3J 3S4
E-mail: entsocmanitobasecretary@gmail.com
http://home.cc.umanitoba.ca/esm/

Entomological Society of Ontario

President	Amro Zayed
President-Elect	Amanda Roe
Past President	David Beresford
Treasurer	Alan Macnaughton
Editor (Journal)	Chris MacQuarrie
Webmaster	Kaitlyn Fleming
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Editor's note: *Society Directors and Officers are reminded to check these lists, and submit corrections, including the names and positions of new officers.*

The last word / Le dernier mot

Cedric Gillott, Editor / Rédacteur

Odds and ends

It's very pleasing to see how well the new series 'Canada's Coolest/Cruelest Insects' has taken off since it began in the *Bulletin* late last year. It's a feature that, we hope, will appeal particularly to the Society's student members as a means of 'getting their feet wet' in the publishing world. A shortish article on an insect (or other arthropod) that especially gets your attention — whether it's the subject of your research or just attracts you for other reasons — is a painless way to develop your scientific writing skills. There are more articles in the pipeline, including additional ones on the insects featured on regional society logos.

In contrast, readers may have noticed the relative dearth of book reviews in recent *Bulletin* issues. So, here's our occasional appeal to members to check the list of books available for review (on pages 60 and 61,and at http://esc-sec.ca/publications/bulletin/#toggle-id-2). (I note that there are quite a number of new listings.) If something appeals to you, contact the Chair of the Publications Committee, and it will be sent to you 'in a flash'. The volume is yours to keep, though if it's unwanted you can always donate it to the students' annual silent auction.

An appeal of a different kind is for help compiling the *Bulletin*'s list of meetings. If you are aware of a meeting with entomological content, even if its theme does not specify 6-legged creatures (e.g., invertebrate pathology, invertebrate hormones, social

Bric-à-brac

Il est très plaisant de voir à quel point la nouvelle série « Ces bestioles les plus cools/cruelles du Canada » a pris son envol depuis son début dans le *Bulletin* à la fin de l'année dernière. C'est une rubrique qui, nous l'espérons, plaira particulièrement aux membres étudiants comme moyen de se lancer dans le monde de la publication. Un article plutôt court sur un insecte (ou tout autre arthropode) qui attire particulièrement votre attention – que ce soit le sujet de vos recherches ou qu'il vous attire pour toute autre raison – est une façon sans douleur de développer vos talents d'écriture scientifique. Il y a plusieurs articles dans la file d'attente, incluant d'autres insectes en vedette dans les logos des sociétés régionales.

Par contraste, les lecteurs ont peut-être remarqué la pénurie relative des critiques de livres dans les récents numéros du *Bulletin*. Voilà donc notre appel aux membres pour qu'ils consultent la liste de livres disponibles pour critique (à les pages 60 et 61, et sur http://esc-sec.ca/publications/bulletin/#toggle-id-2). (Je note qu'il y a un certain nombre de nouveaux livres.) Si quelque chose vous attire, contacter le président du comité des publications et il vous sera envoyé rapidement. Vous conservez ensuite le livre, mais si vous ne désirez pas le conserver, vous pouvez le donner aux enchères silencieuses étudiantes annuelles.

Un appel à tous différent pour de l'aide pour compiler la liste de réunions du *Bulletin*. Si vous avez connaissance d'une réunion avec du contenu entomologique, même si le thème ne spécifie pas de créatures à 6 pattes (p. ex. la pathologie des invertébrés, les hormones des invertébrés, le comportement social), envoyez l'information au rédacteur du *Bulletin* dans un

behavior), send the *Bulletin* Editor an email with the meeting title (and link if available), and I'll do the rest.

Finally, a bit of a gripe. It seems that some regional directors have not yet come to terms with their societal duties, namely, to supply news from their region, to keep the *Bulletin* informed of changes to their local society's list of officials, and if appropriate to submit details of refereed papers in their society's journal. Several regional societies have held their annual meeting in the last few months, with guest speakers, student awards, and other items of interest. Yet, for whatever reason, this information has not been communicated to the *Bulletin*. Why?

courriel avec le titre de la réunion (et le lien si disponible), et je ferai le reste.

Finalement, un peu de plainte. Il semble que certains directeurs régionaux n'ont pas encore accepté leurs responsabilités sociétales, notamment celle de fournir des nouvelles de leur région, de tenir le *Bulletin* informé de changements dans la liste des administrateurs de leur société locale et, lorsqu'applicable, de soumettre des détails sur les articles avec évaluation par les pairs dans la revue de leur société. Plusieurs sociétés régionales ont tenu leur réunion annuelle dans les derniers mois, avec des conférenciers invités, des prix étudiants et d'autres éléments d'intérêt. Cependant, pour certaines raisons, cette information n'a pas été communiquée au

D. Giberson

Eight spotted skimmer, *Libellula forensis* (Odonata; Libellulidae), Sargeant Bay Provincial Park, BC, July 2017.

Entomological Society of Canada, 2019-2020
Société d'entomologie du Canada, 2019-2020

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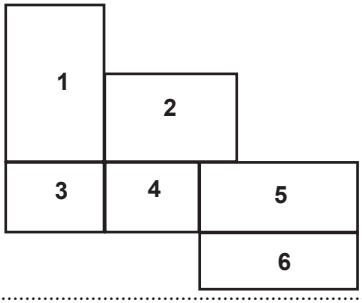

Front cover/Plate supérieur:

1. Praying mantis (Mantodea: Mantidae) having a snack [Summerland, British Columbia, Canada]
Une mante religieuse (Mantodea : Mantidea) prend sa collation [Summerland, Colombie Britannique,Canada]
[Photo: Andrea Brauner]

2. *Apodemia mormo* (Lepidoptera: Riodinidae) individual caught in the wild as part of a captive breeding experiment to help bolster populations of this endangered species [Keremeos, British Columbia, Canada]
Un individu *Apodemia mormo* (Lepidoptera : Riodinidae) capturé en nature dans le cadre d'une expérience d'élevage en captivité afin d'aider à soutenir les populations de cette espèce menacée [Keremeos, Colombie Britannique, Canada]
[Photo: Jayme Lewthwaite]

3. *Platypedia* (Hemiptera: Cicadidae) expands its wings and sclerotises.
Un *Platypedia* (Hemiptera : Cicadidae) étend ses ailes et se sclérifie.
[Photo: Bob Lalonde]

4. Egg parasitoid *Telenomus* (Hymenoptera: Platygastridae) emerging from stink bug (Hemiptera: Pentatomidae) eggs [Delémont, Switzerland]
Des parasitoïdes des oeufs du genre *Telenomus* (Hymenoptera : Platygastridae) émergeant d'oeufs de punaises (Hemiptera : Pentatomidae) [Delémont, Suisse]
[Photo: Tim Haye]

5. *Paralobesia marilynae* (Lepidoptera: Tortricidae) egg hatching six days after oviposition on a showy lady's slipper (Orchidaceae) [Gatineau Park, Québec, Canada]
Des oeufs de *Paralobesia marilynae* (Lepidoptera: Tortricidae) émergeant six jours après la ponte sur le cypripède royal (Orchidaceae) [Parc de la Gatineau, Québec, Canada]
[Photo: Marilyn Light]

6. *Sinodendron rugosum* (Coleoptera: Lucanidae) [Victoria, British Columbia, Canada]
Sinodendron rugosum (Coleoptera : Lucanidae) [Victoria, ColombieBritannique, Canada]
[Photo: Debra Wertman]

Back cover/Plate inférieur:

Tagged Bombus bimaculatus (Hymenoptera: Apidae) queen [Winnipeg, Manitoba, Canada]
Une reine *Bombus bimaculatus* (Hymenoptera : Apidae) marquée [Winnipeg, Manitoba, Canada]
[Photo: Emily Hanuschuk]

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